REPORT TO THE MINISTER OF ENVIRONMENT

on the

PUBLIC INQUIRY

into

THE QUINSAM COAL PROJECT

Province of British Columbia
Ministry of Environment

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REPORT TO THE MINISTER OF ENVIRONMENT

on the

PUBLIC INQUIRY

into

THE QUINSAM COAL PROJECT

at

Campbell River, B. C.
from
October 12th to November 25th, 1983

BY THE COMMISSION

appointed by the Minister of Environment
in accordance with Section 7
Environment Management Act

F. A. Hillier, Chairman
Les Edgeworth, Member
A. J. Lynch, Member

Province of
British Columbia

OFFICE OF THE COMMISSION
Quinsam Coal Inquiry
Room 218, 557 Superior Street
VICTORIA, B. C.
V8V 1X5

Honourable Anthony J. Brummet,
Minister of Environment,
Parliament Buildings,
Victoria, B. C.
V8V 1X4

Dear Mr. Brummet:

re: Quinsam Coal Public Inquiry

The Quinsam Coal Public Inquiry has now been completed and the report on the findings, conclusions and recommendations of your Commission is herewith submitted.

Essentially, the Commission has found that the Quinsam River and its watershed are very sensitive to environmental damage. Notwithstanding this fact, the Commission has also found that if proper care and attention are paid to the environmental aspects of the construction and operation of this mine, by both the Company and the Government control agencies, the mine can be brought into existence and be operated without doing appreciable damage to the surrounding environment or the Quinsam River fishery. The phrase "proper care and attention" applies to the management of the day-to-day operations of the mine, to the design of the control facilities to mitigate possible environmental damage, to the provision of adequate contingency measures for any emergency or unforeseen event, and to the supervision and surveillance program.

The Commission believes that the public hearing had a beneficial effect, not only in crystalizing all of the main issues of concern on the project, but on improving communications between all of the parties involved. The Commission also believes that continued positive communication is essential to the success of

the supervision and surveillance program, and to allay the remaining apprehension of many of the concerned citizens of the Campbell River area.

Further, the Commission regrets the late submission of this report. The Commission experienced considerable delay in obtaining important information which was essential in order that the Commission, in good conscience, could bring down its decision and feel comfortable with that decision.

Yours sincerely,

F. A. Hillier, Chairman

Les Edgeworth

Les Edgeworth, Member

A. J. Lynch

A. J. Lynch, Member

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SYNOPSIS

SYNOPSIS

The following is a synopsis of the findings, conclusions and recommendations of the Commission:

1) THE QUINSAM RIVER SYSTEM:

The Quinsam River system and its watershed are a very sensitive area to potential environmental damage from the operations of the open-pit coal mine. Both the system and its watershed have the characteristics of a virtually undisturbed natural environment. The system also supports a vigorous and valuable fishery, not only in the river system itself, but also in the surrounding salt waters of the Campbell River area. A Federal Government salmonid hatchery is located near the confluence of the Quinsam and Campbell Rivers, about 3 to 4 kilometers from the sea.

2) THE PROPOSED COAL MINE:

The proposed coal mine will be an open-pit operation located 27 kilometers southwest of Campbell River. The expected capacity of the mine is to be some 900,000 M. tonnes of thermal coal per year, with production extending over a fifteen-year period. The coal will be mined from seven or eight open pits immediately east and south of Middle Quinsam Lake and Long Lake, which form part of the Quinsam River system. The coal will be transported over 30.9 kilometers of existing provincial highways and logging roads to Middle Bay, where it will be loaded on to 4,500 M. tonne barges for transshipment to a deepsea British Columbia port.

3) THE SERIOUS POTENTIAL POLLUTANTS:

The serious potential pollutants from the mine-site which could have very harmful effects to the Quinsam River system and the fishery, if not properly controlled, are as follows:

- acid mine drainage and heavy metals which would be toxic to fish life.

- Excessive amounts of suspended solids in the mine effluent which could have deleterious effects on the fish and their spawning grounds.
- Discharge of nutrients (nitrogen and phosphorus) which could cause excessive algal growth in the waters of the Quinsam system, which in turn would be deleterious to water quality and fish production.

4) THE CONCLUSIONS AND RECOMMENDATIONS OF THE COMMISSION:

The conclusions and recommendations on the various environmental aspects of the project which the Commission was directed to investigate, are as follows:

a) General.

The Commission has concluded, after studying all of the evidence presented at the hearing,and all of the information available pertinent to the project, that the mine, and its ancillary facilities, can be constructed and operated, with appropriate mitigative measures, so that the impact to the environment, including the fishery, will be small in nature, provided the recommendations of the Commission are followed. There is no doubt, however, that there will be come changes to the ecosystem in the area, but the Commission firmly believes that these changes would be minimal, provided that adequate surveillance of the operations of the mine takes place and immediate corrective action be instigated in the event that a problem develops, unforeseen or otherwise.

b) The Mine Plan, Acid Generation & Heavy Metals.

Provided the mine plan is followed, no acid generation or heavy metal discharge should take place. If, for some reason, small quantities of acid are generated or heavy metals do leach into the mine effluent, there are mitigative or contingency measures which could be taken to prevent these substances from entering the Quinsam River system.

c) Reclamation.

The Company has presented a reclamation plan for the area which would be appropriate to the future use of the area when mining is completed.

d) Middle Bay Barge Loading Facilities and Haulage Route.

Coupled with the Commission's recommendations, the Company's plans for the Middle Bay barge loading facilities and haul route are satisfactory. The operations of coal trucks along the haul route and the installations at Middle Bay should, therefore, have little impact on the environment.

e) Groundwater.

The Commission concludes from the evidence that both the rock and unconsolidated deposits in the mine-site area have a very low hydraulic conductivity. It appears also that no highly permeable conduits of unconsolidated deposits or faults or fracture zones are present which would allow seeps of undesirable substances to flow from the mine area and into the river or lakes. There is relatively little danger of contamination of the groundwater from the mine operations.

f) Surface Water Management.

The surface water management plan proposed by the Company is satisfactory, with the additions recommended by the Commission.

The suspended solids limit which the Company must maintain in settling pond discharges has been set at 25 mg/liter, based on a 24-hour composite sample. There appears to be no evidence that concentrations of suspended solids less than 25 mg/liter would have any significant harmful effects on the fishery. With this proposed limit, the receiving water suspended solids level would be well below 25 mg/liter.

g) Nutrients.

Large concentrations of nitrogen will be discharged from the mine operations to the Quinsam system. Fortunately, it would appear that future phosphorus levels should not be high enough to cause serious algal problems

The Commission has recommended several mitigative measures which could be taken to limit phosphorus discharges from the mine-site should a problem arise. Both the Company and the Government's regulatory agencies must maintain a rigorous surveillance program. At any indication that the phosphorus discharges are approaching dangerous levels, immediate action must be taken to curtail the discharges in the manner recommended by the Commission. If this is done, the expected nutrient additions to the Quinsam system should not become a problem.

h) Air Quality.

The Commission has reviewed the proposed air pollution controls proposed by the Company for the mine-site, the haulage route and Middle Bay, and has concluded that, coupled with the Commission's recommendations, air pollution should not be a problem.

i) Wildlife.

The proposed operations of the mine should not appreciably affect the quality or quantity of wildlife in the Quinsam River watershed. There is even an opportunity through input to the reclamation plan to improve the value of the reclaimed habitat for wildlife production.

j) Baseline Monitoring.

The current Baseline Monitoring Program is satisfactory, with some additions recommended by the Commission. Additional monitoring information would be desirable subsequent to the evaluation of the existing program. The Commission leaves the details of this program to the Regional Waste Manager of the Waste Management Branch, Ministry of Environment.

k) Supervision and Surveillance.

The proposed Supervision and Surveillance Program is satisfactory, but the Commission believes that it would be desirable, and in the public interest, to include a member of the District of Campbell River on the Environmental Technical Review Committee.

l) Bonding.

The normal practice of the Ministry of Energy, Mines and Petroleum Resources, together with the Commission's recommendations, will provide a satisfactory basis for bonding in regards to reclamation.

The Waste Management Branch bond should be based on a calculation of 50 percent of the estimated capital costs of those settling ponds in operation, the equipment necessary for the disposal of the preparation plant rejects and the emergency or contingency measures to control acid generation and the discharge of nutrients, but should not be less than $1,000,000, nor more than $1,500,000.

Insurance should be provided by the Company in the amount of $10,000,000, which is accessible to the Minister of Environment through the Courts.

m) Permits and Licences.

The Commission is satisfied that the required permits and licences pursuant to the Waste Management Act, the Mines Act, the Coal Act and the Water Act, can now be prepared and issued.

n) Fishery.

The Commission recommends that if the mining operations cause any damage to the Quinsam system fishery, the Company contribute funds in an appropriate amount for habitat rehabilitation and/or enhancement in the Quinsam system.

INTRODUCTION

General.

Quinsam Coal Ltd. (the Company) is interested in the development of an open-pit coal mine in the Quinsam River watershed, some 27 kilometers south-west of Campbell River, B. C. (See Figure 1.0-1 in the map section of this report). The expected capacity of the mine is to be some 900,000 metric tonnes per year of thermal coal. The coal would be mined from seven or eight open pits immediately east and south of Middle Quinsam and Long Lakes,which form part of the Quinsam River system (a graphic description of the pits can be seen in the map section of this report).

A Federal Government salmonid hatchery is located near the confluence of the Quinsam and Campbell Rivers, about 3 to 4 km from the sea. Historically, the Campbell-Quinsam systems have produced good natural runs of all species of salmon, as well as steelhead and cutthroat trout. As a result of over-fishing and habitat problems associated with hydro-electric, forestry and mining developments, the runs became severely depleted. The hatchery, which was constructed in 1974, has now largely restored the salmonid runs to production levels as great, or greater than, the natural production levels in the past.

Both the Provincial and Federal Governments are very concerned about the proposed development. With the economic conditions which currently exist within the Province, it is highly desirable to develop new industry and provide new jobs for our people, particularly for those who are out of work. Equally important, however, in the quest for new industry and new jobs, is the vital need not to damage the environment or destroy our other assets and existing industry, and, particularly in this case, not to destroy, or even impair, the Quinsam River system and its watershed or the salmonid production of the Federal hatchery.

To this end, the Minister of Environment for the Province of British Columbia appointed a three-man Commission to thoroughly look into the matter, examine all of the environmental aspects of the proposed development, and make the appropriate recommendations to him. The Terms of Reference of the Commission are included in Appendix 1, attached to this report.

Purpose of the Inquiry:

The purpose of the Inquiry was to identify the environmental impacts of the proposed coal development, and to identify measures for avoiding and mitigating these impacts. Particular emphasis was to be placed upon protecting fish resources in the Quinsam watershed.

The Inquiry included all the proposed development activities to be undertaken by the Company during construction, operation and abandonment of the mine, within the Quinsam watershed, the area adjacent to the transportation route from the property to the coal transshipment port at Middle Bay, and the community of Campbell River.

Questions to be Resolved:

The Terms of Reference for the Inquiry included only those features of the project which were of an environmental nature. The Inquiry Commission, therefore, did not hear matters concerning the economic or social aspects of the project. The principal questions to be resolved were as follows:

1) Would acid generation be a problem, and if so, how could it be avoided or mitigated?

2) Would nutrient addition (i.e. nitrogen and phosphorus) be a problem, and if so, how could it be avoided or mitigated?

3) What was the level of suspended solids which could be tolerated in the discharge of effluent from the mine-site to the Quinsam River systems?

4) Would there be any other contaminants, such as heavy metals, flocculant or petroleum products, which could be in the effluent discharged from the mine-site and which could cause a problem, and if so, how could this problem be avoided or mitigated?

5) What would be the expected air emissions from the development? Were they a problem, and if so, how could they be taken care of?

6) Would the mine plan, as far as the environmental requirements are concerned, be acceptable? Would the reclamation plan be acceptable?

7) Would there be any environmental problems in connection with the transportation route and the load-out facilities at Middle Bay?

8) Could the fishery be adequately protected, even with the best of pollution control equipment and the best of intentions on the part of the Company?

9) Are there adequate base-line data?

10) Is the supervision and surveillance program proposed by the Company and the Government control agencies adequate? What are the procedures and are they adequate?

11) What are the problems with wildlife protection?

12) What are reasonable levels of bonding in relationship to the Mines Act and the Waste Management Act?

13) Having considered all of the foregoing questions, should the mine be allowed to come into existence?

The Approval Process:

The Provincial Government has set up an extensive review process for each new mining project. For coal mines, this process has been set up pursuant to the Guidelines for Coal Development (ELUC-1976).

This process has benefits to the mining industry, for it provides that industry with one overall point of contact with the Province, and insures that, through a simple review procedure, all Provincial concerns and requirements will be met.

The process is co-ordinated by the Coal Guidelines Steering Committee. This inter-ministry committee is chaired and co-ordinated by Ministry of Energy, Mines & Petroleum Resources (MEMPR), the lead agency, and reports to the Environment and Land Use Committee of Cabinet (ELUC).

The Steering Committee circulates mining company submissions to all participating Provincial ministries (usually about fifteen), and also to Federal Departments such as Environment, Fisheries and Oceans, and Indian and Northern Affairs (if appropriate). Review comments are received and compiled by the Steering Committee. With this information, reports may then be made to ELUC and/or advice forwarded to the companies.

Therefore, in order to bring a new mine into production in British Columbia, the proponent is required to carry out the following procedures:

1) After the company has conducted its exploration program (under exploration tenures), and has concluded that the proposed mine is probably economically viable, the company must then file a prospectus with the Ministry of Energy, Mines and Petroleum Resources. This document notifies the Province that the company is giving consideration to a particular new mining project and is making application for a government review. The prospectus contains conceptual information on the proposed project of a very preliminary nature.

2) Once the Government has reviewed the company's prospectus, and after discussions with the relevant ministries, and acceptance of the prospectus by the Government, the Company is

then invited to proceed to the next step of the review process, which is the Stage I submission. The Stage I submission contains a more advanced preliminary design of the project (including off-site ancillaries) and a preliminary environmental and socio-economic impact assessment.

3) Once the review of the Stage I submission has been completed by the various ministries and found to be generally acceptable, the company is then invited to proceed with the Stage II submission. The Stage II submission is a detailed project design and impact assessment report. Depending on the information given in the Stage I report, the Government may give direction to the company to provide certain specific information in the Stage II report.

4) The Stage II submission is the most important decision document. Following the Stage II review, the Steering Committee makes its recommendations to ELUC on the question of giving the company approval-in-principle for the project.

5) When ELUC grants Stage II approval-in-principle, the project proceeds to Stage III, the licencing stage. The Stage II approval-in-principle authorizes the regulatory agencies of government to finalize and issue the required licences, permits and other necessary approvals prior to mine construction and operations.

One of the conditions of the Environment and Land Use Committee for granting the Stage II approval-in-principle to Quinsam Coal Ltd. was that there be a public inquiry into the environmental aspects of the proposed project prior to permitting and licencing, and that the questions outlined in the foregoing section of this report be answered by the Inquiry Commission to the satisfaction of the Minister of Environment.

Hearing Information:

The hearing took place at the Anchor Inn and at the District of Campbell River Municipal Hall, in Campbell River, B.C., between October 12th, 1983 and November 25th, 1983. During that period of time, the hearing was in session for twenty days.

The announcement by the Minister of Environment concerning the "Terms of Reference" for the Quinsam Coal Public Inquiry and the appointment of commissioners to conduct the Inquiry, was made on August 10th, 1983.

All intervenors wishing to make presentations to the Commission were required to notify the Commission of their intentions,and to submit an outline of their presentations by September 30th, 1983,in order to qualify as Registered Intervenors.

The Commission invited representatives from the Provincial Government (Ministry of Environment and Ministry of Energy, Mines & Petroleum Resources), and the Federal Government (Environment, and Fisheries and Oceans) to attend the hearing, make presentations, answer questions, and in every way, to take part in the hearing on the same basis as a regular intervenor.

The Company's presentation documents were required to be filed by 2:00 p.m. on October 7th, 1983, with the Commission, and at the Company's storefront office in Campbell River, B.C., for the public.

All other participants to the Public Inquiry were required to file copies of their presentations on the first day of the hearing at the Anchor Inn, in Campbell River, B. C.

The Company made its presentation at the start of the hearing and was then subjected to cross-examination by the registered intervenors, the Government agencies, members of the audience and the Commissioners. The other participants to the Public Inquiry were allowed to revise their presentations subsequent to hearing the Company's testimony. The Company was given the opportunity to submit rebuttal evidence at the end of the hearing, which it did not do.

Each of the registered intervenors made his or her presentation after the Company's presentation, and was then subjected to cross-examination by the other registered intervenors, the Government agencies, members of the audience, the Company and the Commissioners.

The Government agencies made their presentations at the end of the hearing, with the Federal Government agencies making a joint presentation first. The Government agencies were then subjected to cross-examination from the registered intervenors, members of the audience, the Company and the Commissioners.

All testimony was given under oath.

At the start of the hearing, the Commission was put on notice by the Registered Intervenor, Vancouver Island Resources Society, that it would be making an application to the Supreme Court of British Columbia for a Judicial Review of the procedures of the Commission, primarily in respect of the fact that the Society, as well as all the other intervenors, had not been given sufficient time, after the Company had filed its presentation, for them to prepare an adequate presentation (including cross-examination) of their own. The Supreme Court denied the application.

The Commission's costs for the hearing, including preparation, the hearing itself, subsequent investigations, and the preparation of this report, are estimated to be in the order of $75,000. It is suggested that the costs incurred by the other four Government agencies, in total, would be somewhere in the order of double this figure, and that the costs to the Company and the registered intervenors would probably exceed those of both the Government agencies and the Commission combined. The total estimated cost for all participants to the public inquiry hearing is estimated to be in the order of $500,000 to $600,000.

The hearing was recorded on two sets of audio tapes. One set will be kept for 5 years, the other for one year. No transcript will be made, but the tapes will be available to the public, but only for use at the following address:

Room 218, 557 Superior Street, Victoria, B.C.

In addition, a copy of all of the briefs submitted to the Commission will be kept at the foregoing address.

A request from a number of the registered intervenors was made at the hearing that the final report of the Commission (this report) be made available to the public. The Commission now makes this recommendation to the Minister of Environment.

THE PARTICIPANTS

General:

The people and/or organizations who took part in the hearing included the Commission, the Company and their consultants, the Registered Intervenors and their witnesses and consultants, the Federal Government's Departments of Environment, and Fisheries and Oceans, and the Provincial Government's Ministries of Environment, and Energy, Mines & Petroleum Resources.

The hearing was well covered by the local press and radio station, and, in addition, the whole of the hearing was televised by the local television station and shown each evening in Campbell River, B.C., from 6:00 p.m. onwards.

Initially, 47 intervenors registered with the Commission and stated they would make presentations at the hearing. In actual fact, only 40 filed briefs with the Commission (and some of those not on the first day of the hearing), and only 36 intervenors appeared before the Commission to make their presentations. The Commission ruled that it could not consider the four other briefs which were filed with the Commission, but not presented by their authors, on the basis that the information presented in these briefs was not open to cross-examination

In addition to those individuals and groups who were registered with the Commission to give presentations and conduct cross-examination, the Commission also opened up the hearing to the audience for questions. Of those members of the audience who took advantage of this privilege, three in particular rose may times to question the registered participants. These persons were Al Quine, Quentin Dodd and Robbie Clark.

The registered participants to the hearing were as follows:

The Commission:

Mr. Frank A. Hillier, P. Eng. - Chairman
Mr. A. J. Lynch, M.Sc. - Member
Mr. Les Edgeworth, P. Eng. - Member

Miss Shirley Mitchell - Official Recorder & Executive Secretary

The Company:

Mr. Jim O'Rouke, P. Eng. - President, Quinsam Coal Ltd.
Mr. Tom Milner, P. Eng. - Manager of Engineering, Quinsam Coal Ltd.
Mrs. Mary Collins - Manager, Community Relations, Quinsam Coal Ltd.
Mr. Peter Butler - Legal Counsel

Consultants

Mr. Norm Guild, P. Eng. - Ker, Priestman & Associates Ltd.
Mr. Bill Brown, P. Eng. - Brown, Erdman & Associates Ltd.
Mr. Ab Bruynesteyn, B.A.Sc. - B.C. Research
Mr. Andrew Sobek, M.Sc. - Engineers International Inc.
Dr. Jim Malick, Ph.D. - Norecol Environmental Consultants Ltd.
Mr. David Polster, M.Sc. - " " "
Dr. Rob Hawes, Ph.D. " " "
Mr. Brent Lister, B.Sc. - B.D. Lister & Associates

The Intervenors:

1. April Point Fly Fishing Club
   - represented by W. P. Peterson
2. Associated Chambers of Commerce of Vancouver Island
   - represented by Colin Smith
3. B.C. Wildlife Federation
   - represented by W. R. Harling
4. Mr. Barry Baldwin

5. District of Campbell River
   - represented by Mr. R.V. Ostler,Mayor
     Ms. Carol Ross - Legal Counsel
   - Consultant - Mr. Ross Peterson, M.Sc.,
     Howard Paish & Associates Ltd.

6. Campbell River Estuary & Watershed Society
   - represented by Don McIvor

7. Campbell River & District Fish & Wildlife Association
   - represented by Norene Devlin

8. Campbell River Residents in Support of FACTS
   - represented by Jan McDade & Wayne Pernu

9. Campbell River & District Fishing Guides Association
   - represented by R. D. Berger

10. Campbell River, Courtenay & District Labour Council
    - represented by Cameron McLean

11. Canadian Paper Workers Union (Local 1123)
    - represented by Dave Owen & Donald McLean

12. Mr. Horace Calnan

13. Discovery Guides Ltd.
    - represented by Jeremy Maynard

14. Green Party - Campbell River
    - represented by Jeremy Maynard

15. Mr. M.B. Gage

16. Haig-Brown Kingfisher Creek Society
    - represented by John Grant

17. International Union of Operating Engineers (Local 115)
    - represented by Kevin Rundle

18. Mr. John Keays

19. Mrs. Rita Kerr

20. Mr. Duncan Marshall

21. Ms. Ruth Masters

22. Mr. W. P. Peterson

23. Mrs. R. E. Pengelley

24. Pacific Trollers Association
 - represented by Guy Adams

25. Regional District of Comox-Strathcona
 - represented by Keith A. Hudson

26. Mr. William C. Rogers

27. River Sportsman Ltd.
 - represented by Bob MacKenzie

28. Kevin Rundle

29. Society Promoting Environmental Conservation (SPEC)
 - represented by Jim Erkiletian

30. Steelhead Society of B. C.
 - represented by Robert Bell-Irving, and
 G.P. Sinnott, LL.B. - witness

31. Sierra Club of Western Canada
 - represented by Shirley Duncan

32. Tyee Club of British Columbia
 - represented by Stan Patterson, and
 R. D. Berger, witness

33. United Brotherhood of Carpenters & Joiners of America (Local 1882)
 - represented by Fred Kuhn

34. United Fishermen and Allied Workers Union (Local 17)
 - represented by Mike Murphy

35. Mr. Ronald Wilkins

36. Vancouver Island Resources Society (VIRS)
 - represented by Dr. Richard Murphy, M.D.
 Mr. John Brandon, P. Eng.
 Ms. Marilyn Kansky, Legal Counsel

 - Consultants - Dr. Barry Phelps, Ph.D., P. Eng.
 Pennsylvania State University
 - Mr. Robert M. Hershey, P. Eng.
 Meiser & Earl, Hydrogeologists
 - Dr. J.A. McCarter, Ph.D.
 J.A. McCarter & Associates

The Federal Government:

Mr. John N. Millen, P.Eng. - Chief, Ecological Protection Group, Environment Canada

Mr. Keith Ferguson, M.A.Sc.- Head, Mining and Metallurgy Program, Pollution Control Group, Environment Canada

Mr. Wayne Knapp, Dipl.BCIT - Senior Biological Technician, Fisheries & Oceans Canada

Mr. M.D. Nassichuk, M.Sc. - Chief, Water Quality Unit, Habitat Protection Division, Fisheries & Oceans Canada

Dr. John Stockner, Ph.D. - Section Head, Enrichment Research Fisheries & Oceans Canada

The Provincial Government:

A. Ministry of Energy, Mines & Petroleum Resources

Mr. J.D. McDonald, P.Eng. - Acting Director, Mineral Policy and Evaluation Branch

Mr. D.M. Galbraith, P.Eng. - Reclamation Inspector

Dr. J.C. Errington, P.Ag. - Reclamation Inspector

Mr. D. Murray, P. Eng. - Environmental Control Officer

Mr. R.T. Martin, P. Eng. - Geotechnical Inspector

Mr. H. Dennis, P. Eng. - Senior Coal Mines Inspector

B. Ministry of Environment

Dr. Jon O'Riordan, Ph.D. - Director of Planning & Assessment

Dr. B. Hollingshead, Ph.D. - Regional Manager, Vancouver Island Water Management Branch

Mr. G.E. Oldham, P.Eng. - Regional Manager, Vancouver Island Waste Management Branch

Mr. D.C. Morrison, M.Sc. - Regional Habitat Protection Officer, Vancouver Island, Fish & Wildlife Branch

Mr. J.C. Lyons, B.Sc. - Regional Director, Vancouver Island

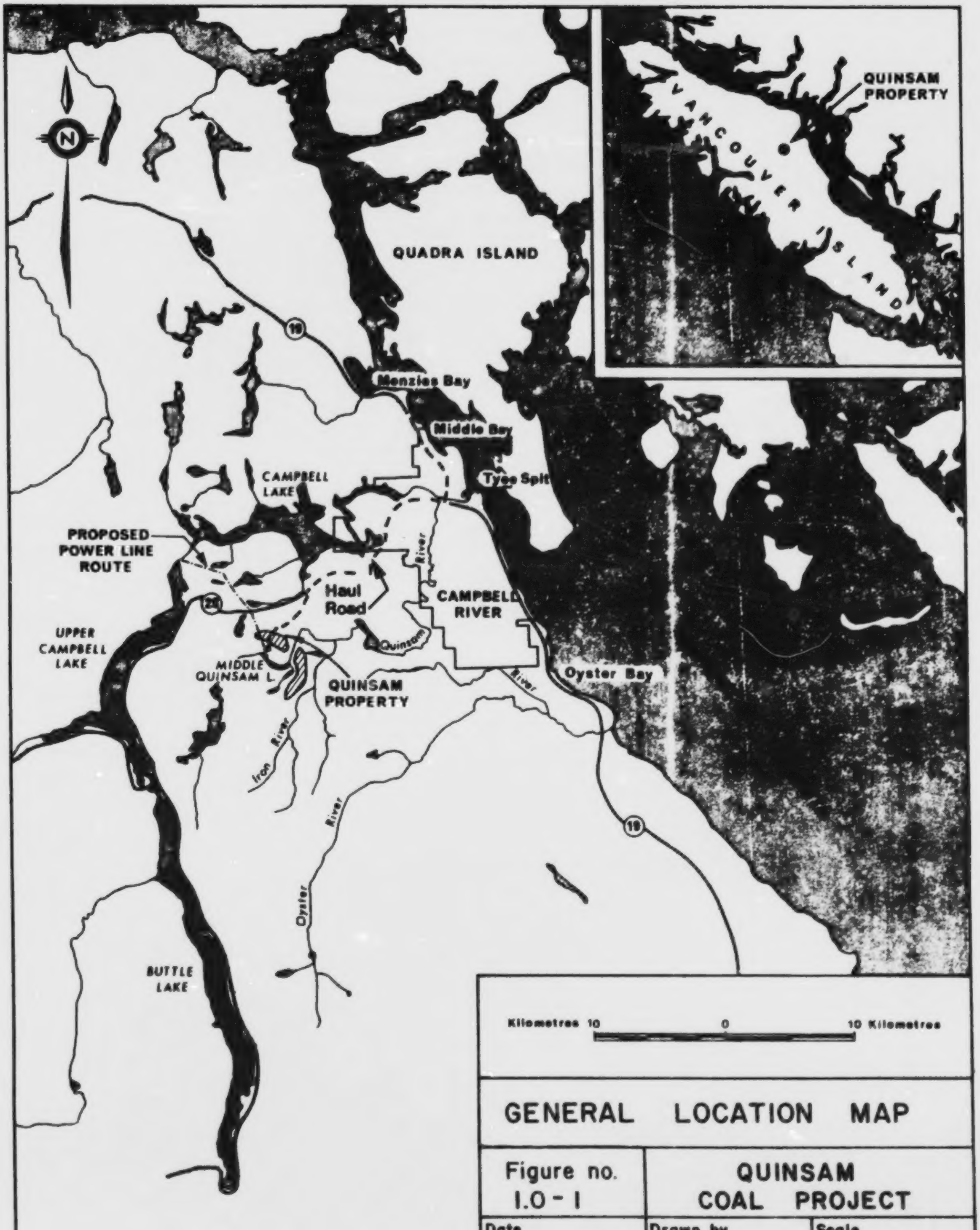
Witness:

Mr. John Sturm, M.Sc. - Sturm Environmental Services, Bridgeport, West Virginia, U.S.A.

MAPS

and

DIAGRAMS


QUINSAM PROPERTY
VANCOUVER ISLAND
QUADRA ISLAND
19
Menzies Bay
Middle Bay
Tyee Spit
CAMPBELL LAKE
PROPOSED POWER LINE ROUTE
28
Haul Road
River
CAMPBELL RIVER
Quinsam
UPPER CAMPBELL LAKE
MIDDLE QUINSAM L.
QUINSAM PROPERTY
Oyster Bay
River
Iron River
Oyster River
19
BUTTLE LAKE
Kilometres 10
0
10 Kilometres

GENERAL LOCATION MAP

Figure no. 1.0 - 1	QUINSAM COAL PROJECT

Date JULY 1982 | Drawn by BRINCO | Scale As shown

QUINSAM COAL LIMITED

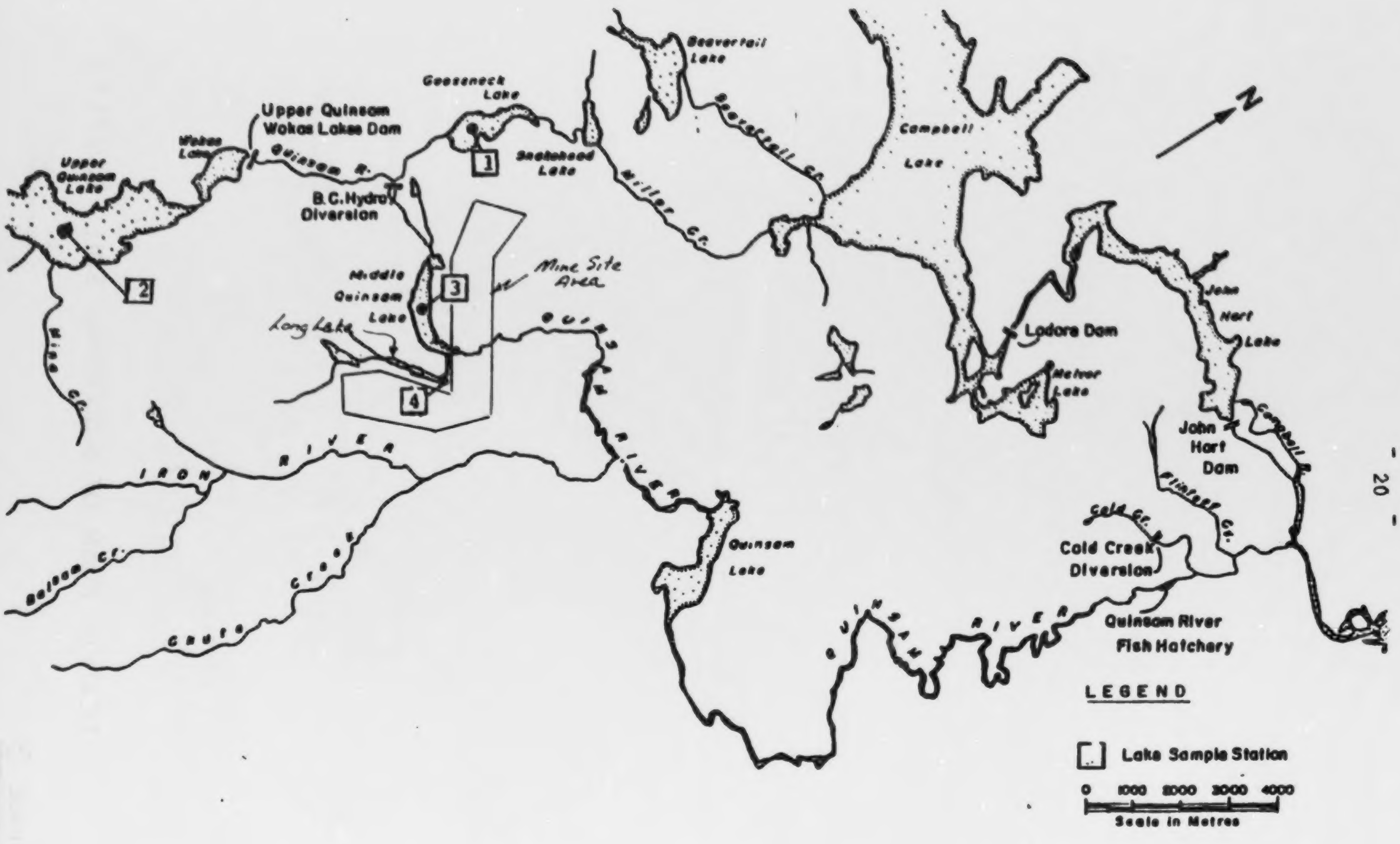
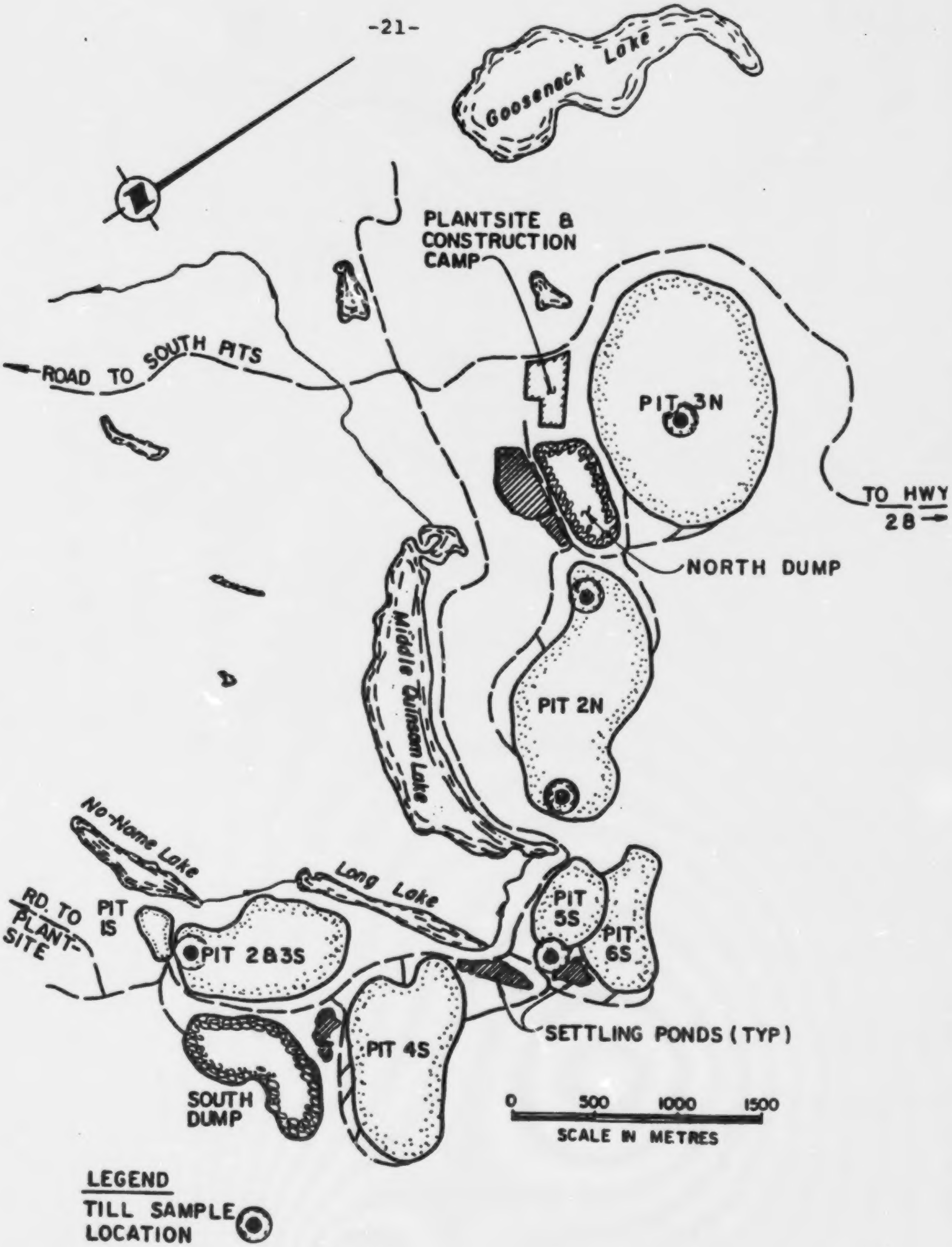
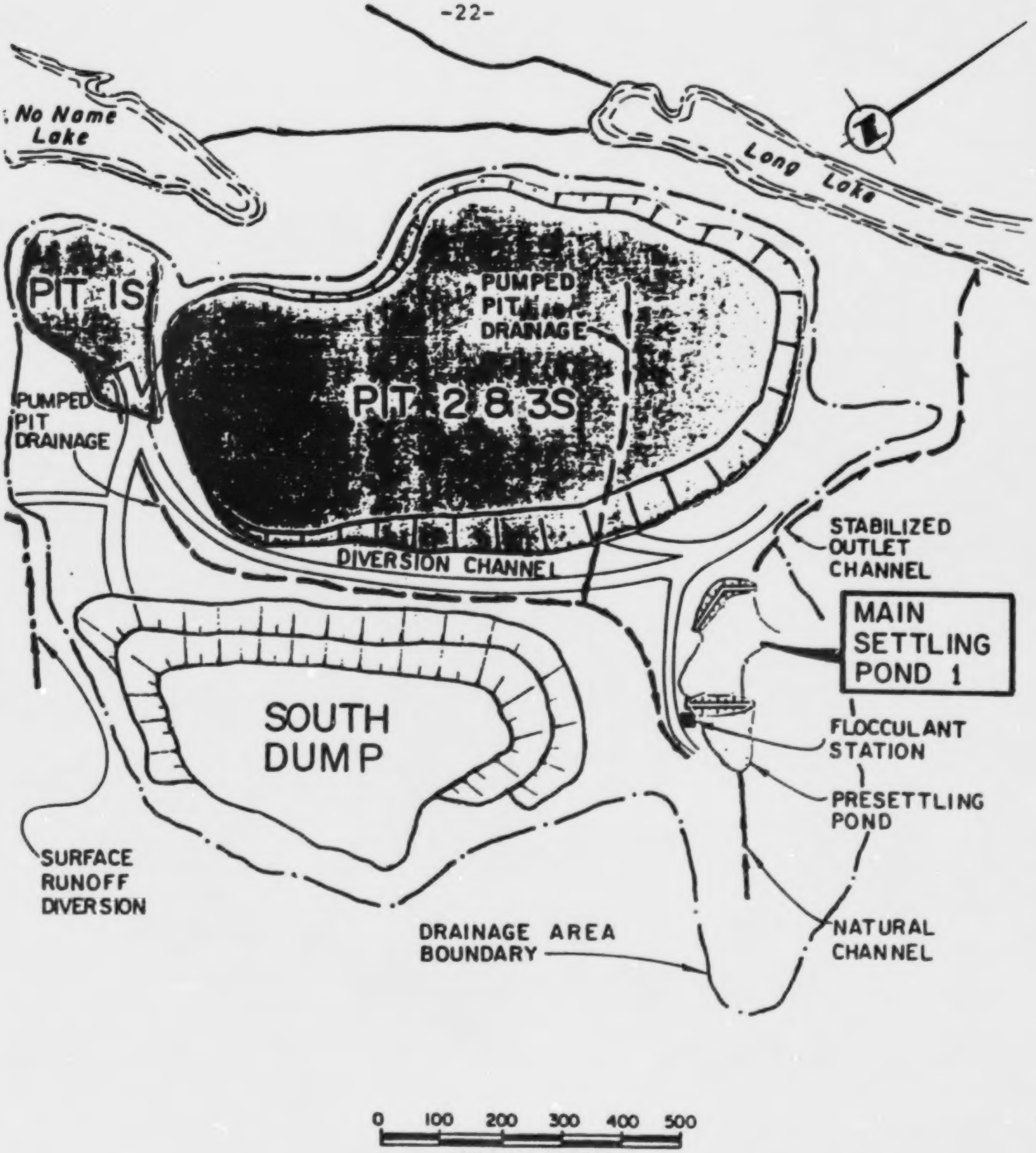

N
Upper Quinsam Lake
Wokas Lake
Upper Quinsam Wokas Lakes Dam
Quinsam R.
Goosenack Lake
Snakehead Lake
Beavertail Lake
Beavertail Cr.
Miller Cr.
Campbell Lake
B.C.Hydro Diversion
Middle Quinsam Lake
Long Lake
Mine Site Area
1
2
3
4
Ladore Dam
McIvor Lake
John Hart Lake
John Hart Dam
Campbell R.
Flintoff Cr.
Cold Cr.
Cold Creek Diversion
Quinsam River Fish Hatchery
Quinsam Lake
Quinsam River
Iron River
Nine Cr.
Blason Cr.
Chute Creek
LEGEND
Lake Sample Station
0 1000 2000 3000 4000
Scale in Metres

FIGURE 2 QUINSAM DRAINAGE BASIN SHOWING SAMPLE SITE LOCATIONS


Gooseneck Lake
PLANTSITE & CONSTRUCTION CAMP
ROAD TO SOUTH PITS
PIT 3N
TO HWY 28
NORTH DUMP
Middle Quinsam Lake
PIT 2N
No-Name Lake
Long Lake
RD. TO PLANT-SITE
PIT IS
PIT 2&3S
PIT 5S
PIT 6S
SETTLING PONDS (TYP)
PIT 4S
SOUTH DUMP
0
500
1000
1500
SCALE IN METRES
LEGEND
TILL SAMPLE LOCATION

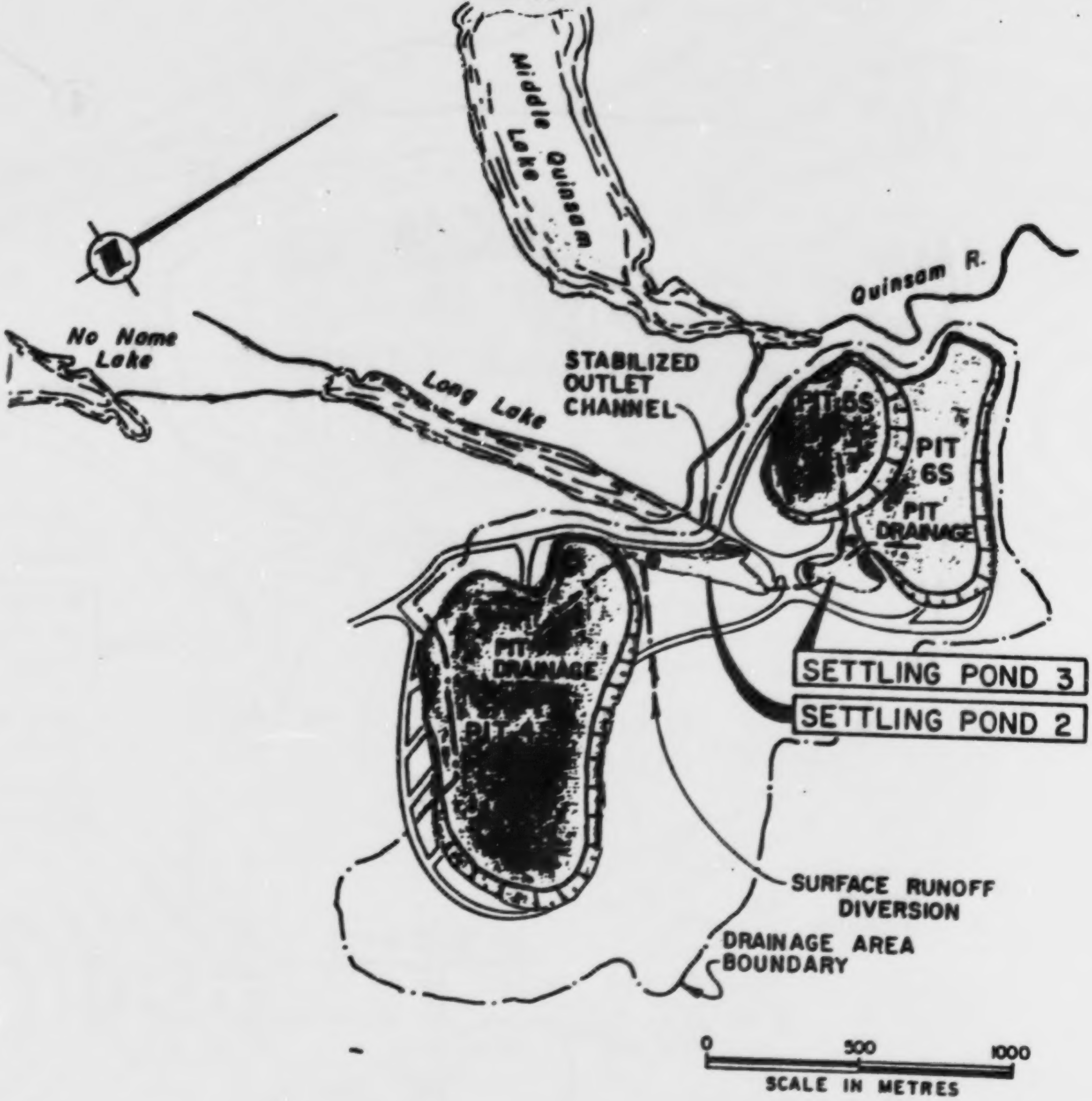
LOCATION PLAN OF SURFICIAL SOIL SAMPLES

FIGURE 3


No Name Lake
Long Lake
PIT 1S
PUMPED PIT DRAINAGE
PIT 2 & 3S
PUMPED PIT DRAINAGE
DIVERSION CHANNEL
STABILIZED OUTLET CHANNEL
MAIN SETTLING POND 1
FLOCCULANT STATION
PRESETTLING POND
SOUTH DUMP
SURFACE RUNOFF DIVERSION
DRAINAGE AREA BOUNDARY
NATURAL CHANNEL
0
100
200
300
400
500
SCALE IN METRES

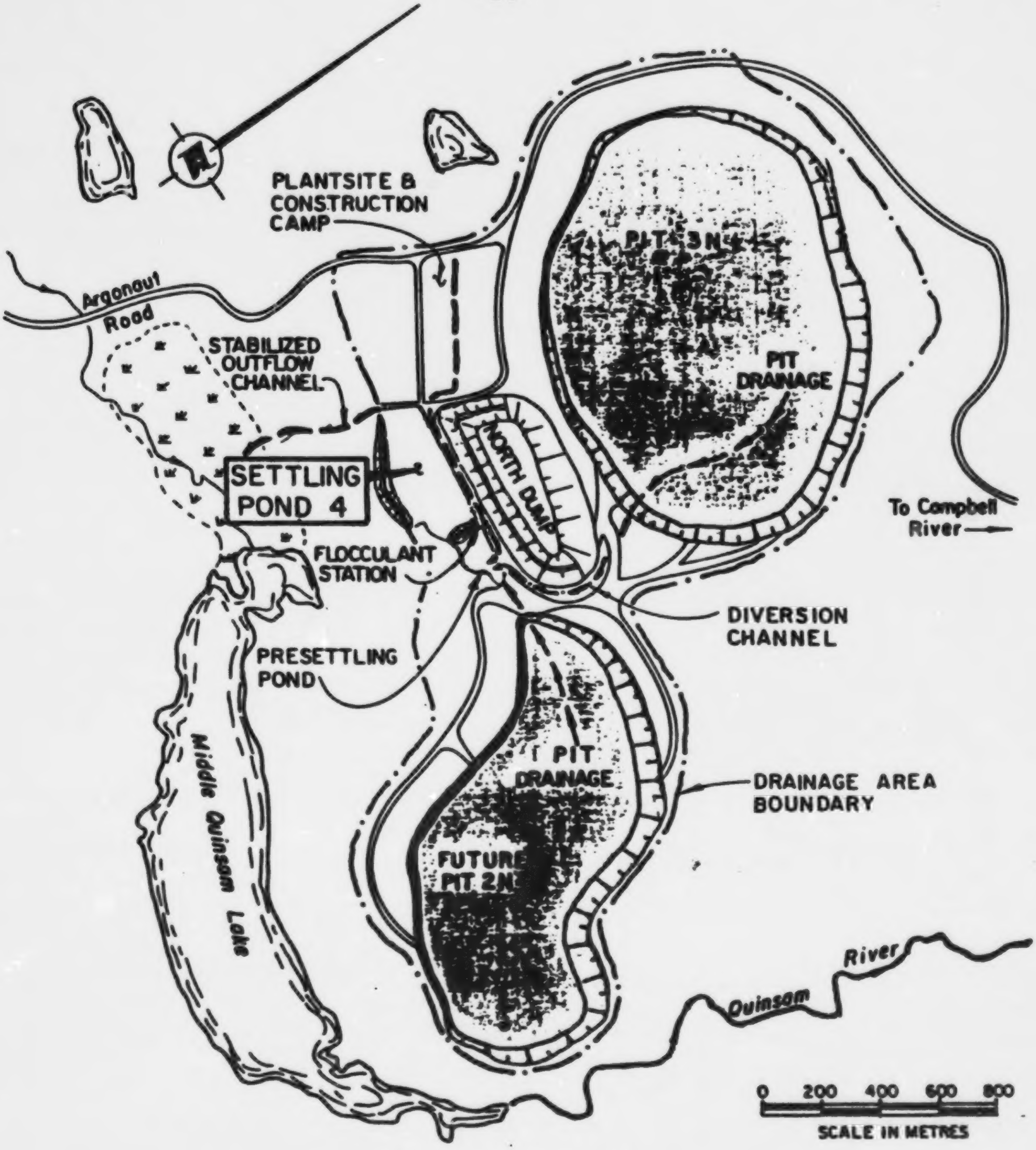
SETTLING POND 1
WATER MANAGEMENT PLAN

FIGURE 4


Middle Quinsam Lake
Quinsam R.
No Name Lake
Long Lake
STABILIZED OUTLET CHANNEL
PIT 5S
PIT 6S
PIT DRAINAGE
PIT DRAINAGE
PIT 4
SETTLING POND 3
SETTLING POND 2
SURFACE RUNOFF DIVERSION
DRAINAGE AREA BOUNDARY
0
500
1000
SCALE IN METRES

SETTLING PONDS 2 & 3
WATER MANAGEMENT PLAN

FIGURE 5


PLANTSITE & CONSTRUCTION CAMP
PIT 3N
PIT DRAINAGE
Argonaut Road
STABILIZED OUTFLOW CHANNEL
SETTLING POND 4
NORTH DUMP
To Campbell River
FLOCCULANT STATION
DIVERSION CHANNEL
PRESETTLING POND
Middle Quinsam Lake
PIT DRAINAGE
FUTURE PIT 2N
DRAINAGE AREA BOUNDARY
Quinsam River
0 200 400 600 800
SCALE IN METRES

SETTLING POND 4
WATER MANAGEMENT PLAN

FIGURE 6

SUMMARY OF THE COMPANY'S PRESENTATION

PROJECT AND COMPANY PLANS:

The President of the Company gave the following information to the Commission.

1) The Company welcomes the public inquiry and believes that the public must have the comfort of knowing that the environmental evaluations have been properly interpreted by qualified professionals who are willing to present their evaluation in a public forum, under oath.

2) The Company has maintained an open-book policy, and it has maintained a very active program through its Campbell River office of making available to the public its reports and consultants.

3) The Quinsam Coal Company is a British Columbia Company, incorporated in 1976. The two owners of the Company are Brinco Limited, and Weldwood of Canada Ltd., each holding 50 percent of the shares.

4) Brinco Limited is a Vancouver-based Canadian resource development company, and is the Manager of the Quinsam Project.

5) Weldwood of Canada Ltd. is a Vancouver-based Canadian forest company, which,in 1964, acquired the assets of Canadian Colleries Ltd. that included the coal rights held in fee simple, granted by the Esquimalt and Nanaimo Railroad Land Grant.

6) The Quinsam Coal Project involves the development of more than 300 million tonnes of high volatile thermal coal reserves.

7) More than $7,000,000 have been spent to date on exploration, engineering and environmental studies, concerning the project.

8) In the past two years, the Company has spent approximately $3,000,000, most of which has been directed

at the environmental testing and evaluation for the preparation of the Stage II Addendum and the permit applications. The Stage II report and its Addendum were part of the requirements of the Provincial Government in order to give the Company approval-in-principle for its project.

9) The total capital cost for the development is estimated at close to $100,000,000. The mine will employ up to 300 people over the estimated two-year construction period.

10) Annual operating costs are expected to exceed $30,000,000. Total employment for operations is expected to reach 250 people.

11) The operations will include the following:

    a) surface mining - reclamation systems

    b) a coal preparation plant

    c) a truck transportation system (i.e. from mine to Middle Bay)

    d) a barge loading facility

12) During the second half of 1981, and throughout 1982, the main thrust of the Company's activities have been directed to environmental and design studies to ensure that the potential impacts of the project and the mitigative measures were thoroughly understood and evaluated. Significant changes were made to the design of the development to add special precautionary measures against environmental upsets, etc.

13) The Stage II Addendum, which is the revised and up-to-date Environmental Assessment Report, was submitted to the Government and the public in August of 1982.

14) The Environment and Land Use Committee has granted the Stage II Approval-in-Principle to the Quinsam Coal Project for 15 years of operations.

15) Also, in conjunction with the public inquiry hearing into the project, the Company is now authorized to complete negotiations with Provincial agencies on specific terms and conditions for the various licences, permits and other approvals which must be obtained prior to coal production.

The Manager of Community Relations gave testimony to the Commission concerning the Company's public relations with the Community and the extent to which information on the development of the project has been passed along to the public. Some of her testimony was as follows: (Commission's Summary)

1) The first purpose of the Company's community relations program has been to communicate information about the project plans to the community as a whole, and within the community, to groups, service clubs, school children, and individuals with specific interest or concerns.

2) The second purpose of the community relations program has been to listen to questions and concerns of key individuals and organizations in the community as well as from the general public about the Quinsam Coal Project, and to answer these questions, and,where appropriate in a number of cases, actually to adapt project plans to address these concerns.

3) The Company has put on 24 public tours of the mine site, which also included a presentation on the project. Over 550 people have participated in these tours.

4) Over 500 people have attended six open-house meetings on the project. Eighteen public meetings or information sessions have been held. Five technical workshops have been held, at which the Company's consultants have made their research and findings available to the public, including the answering of questions from the public.

5) In 1982, the Company took a group of local community leaders from Campbell River to visit the surface coal mining operations of Widco Incorporated, in Centralia, Washington, to show these people that it was possible for a surface coal mine to be operated with proper protection to the environment.

6) Fifteen separate issues of the Quinsam Update newsletter have been distributed to all households and businesses, both in Campbell River and throughout the North Island, with a total distribution of

17,500. This newsletter provides background information and progress reports on the project.

7) A video-tape has been prepared on the project and made available to the public.

8) A store-front office has been opened in Campbell River, in order to make information available to the public on the project. During 23 months of operations, the office has had over 14,000 visitors.

9) The Stage II Addendum, all background reports, and all recent data, have been available at the Campbell River office, as soon as they have been published.

The Manager of Engineering gave testimony to the Commission concerning the physical and geological properties of the mine site, the characteristics of the coal, the mine plan, and a description of the project facilities. Some of his testimony was as follows: (Commission's Summary)

1) Quinsam Coal Ltd. plans to develop a thermal coal mine in the Middle Quinsam Lake area, approximately 27 km. southwest of Campbell River.

2) The transportation of clean, washed coal from the mine site to the barge loading facility at Middle Bay will be done by covered truck (capacity - 36.3 M tonnes) over 30.9 km. of existing Provincial highways and logging roads.

3) The Middle Bay barge loading facility will be constructed on 5.8 ha. of water-front property, about 1.5 km north of the pulp and paper mill, or about 9 km. north of the town of Campbell River itself. Barge capacity will be 4500 M tonnes each.

4) Exploration activities on the mine site included a total of 503 geophysically-logged holes and 56 cored exploration holes, drilled on an average 75M by 150M grid to define the coal reserves. In addition to the drilling program, four test pits were excavated from which 72 M tonnes of bulk samples were recovered.

5) In the middle Quinsam Lake area, the geological formation (Comox) consists of up to 120M of marginal continental sediments. These sediments were laid down in two distinct depositional cycles. The lower cycle

consists predominantly of medium green-grey to brown siltstone, mudstone and one major coal seam (Seam No. 1) averaging 3 to 4 m in thickness. The upper cycle consists primarily of white to grey, medium to coarse-grained calcareous arkosic sandstone, with minor siltstone, mudstone and two coal seams (Seams Nos. 2 and 3). Seam No. 2 averages 1.2 m. in thickness and Seam No. 3 (the closest to the surface of the ground) averages 4.5 m. of interbedded coal and rock bands. The average separation between Seam 1 and Seam 3 is approximately 60 m. The Comox formation sediments, in general, dip uniformly to the northeast at angles of 6° to 10°. The overall geological structure is relatively uncomplicated with very few faults.

6) The geological coal reserves are 37,675,000 M tonnes summarized as 17,939,000 M tonnes proven, 16,561,000 M tonnes probable and 3,175,000 M tonnes possible.

7) The existing mine plan is based on the proven reserves of 17,939,000 M tonnes, which are contained in Pits 1S, 2-3S, 4S, 5S, 6S, 2N and 3N.

8) Strip ratio is 8.6 bank cubic meters per M tonne raw coal average.

9) The raw coal quality is as follows:

   a) Ash averages 26% and ranges from 19.5% to 50%.

   b) Sulphur averages 1.36% and ranges from 0.5% to 3.8%.

   c) Inherent moisture content averages 3.0% and ranges from 2.6% to 3.5%.

   d) Surface moisture content will average 4% and range from 2% to 7%.

   e) The calorific value, excluding ash, is 7800 kcal/kg. which classifies Quinsam Coal as a high volatile bituminous "A" coal.

10) Clean coal quality out of the preparation plant, where washing and blending have taken place from the various pits, is as follows:

   a) Yield - 68% average

   b) Ash Content - 8.5% to 12.5% on an air-dry basis.

   c) Sulphur - below 1.0%.

d) Fuel Ratio - 1.24 (Fixed Carbon divided by Volatile Matter)

e) Gross Calorific Value - 6700 Kcal/kg on an air-dry basis

f) Hardgrove value - 45 to 50, which means the coal is relatively hard with low levels of fines, which will result in minimal handling problems and low dust losses.

g) Ash properties demonstrate minimum tendencies towards slagging and fouling.

11) The initial mine development will be concentrated on Pits 1S and 2-3S for the first year's coal production. Coal production from year 2 onward will be a blend of approximately 70% from the north pits and 30% from the south pits. Mine production will build up as follows:

Pre-production = 2,900,000 M^3

Year 1 = 6,500,000 M^3

Year 2 = 9,670,000 M^3

Year 3 onwards = 11,580,000 M^3

12) Some of the revisions which have been made to the original mining plan are as follows:

a) Pit boundaries have been pulled back from water courses and lakes.

b) Coal mining during the life of the mine will be restricted to three pits and two, where possible. Pits will be mined to their ultimate highwall, back-filled and reclaimed in a continuous sequence.

c) Mine plan alterations have been made to reduce the amount of road construction required.

d) Plant-site buildings have been relocated to higher ground further away from Middle Quinsam Lake.

e) Make-up water for the coal preparation plant will be reclaimed from the settling pond adjacent to the plant-site.

f) Domestic water will be obtained from Gooseneck Lake and no water will be withdrawn from the Quinsam River watershed.

13) Extensive drilling and blasting of both the overburden and the coal will be required. Estimated annual explosives will amount to 6,700,000 kg., made up of 10% water gelatine blasting agents and 90% ammonium nitrate (ANFO).

14) Mine waste rock disposal will be limited to the out-of-pit dump areas, one northeast of the plant-site and one south of the 1S, 2-3S pits. Out-of-pit disposal will only take place during the intial stages of mining, until enough coal has been removed to allow for continuous in-pit back-filling. Once in-pit back-filling operations are established, the normal operation will deposit waste rock in the area where the coal has been mined out. This will be followed by back-filling with a glacial till layer and a top soil cover to facilitate reclamation.

15) During the dry summer months, dust will be suppressed by drawing water from the settling ponds for watering the road surfaces.

16) The location of mine haulage routes has been selected to keep them as far removed from Middle Quinsam Lake and the Quinsam River as is practical. Mined coal haulage roads have been designed to allow for two-way traffic with 46 M tonne haulage trucks. Roads will be 30 M wide and maximum road grade will be limited to 8 percent.

17) The coal preparation plant has a nominal capacity of 270M tonnes/hr. Raw coal is blended in the feed to the plant from separate stock piles. The raw coal is crushed to 100 mm, washed with water, and then further crushed to product size of 38 mm. Waste rock and coal are separated. The clean coal is then either stockpiled at the site or sent by truck to Middle Bay. Waste rock is returned to the mine out-pits. Water is clarified in a thickener and recylced within the preparation plant. Thickener filter cake is disposed of in the same manner as the

waste rock. There is no water discharged from the preparation plant to the settling ponds. Total rejects consist of 60% waste rock and 40% filter cake.

18) Maximum domestic water requirements from Gooseneck Lake are estimated to be 8300 liters/day, or 15.40 US gals/min.

19) Sanitary sewage facilities will be designed for 400 persons. The facilities will consist of a pre-fabricated domestic plant with discharge through a standard disposal field to the ground. The sewage will contain nitrogen and phosphorous.

20) Other plant-site facilities will include an office, a change-house, a maintenance shop/warehouse complex, an assay laboratory, a high explosives magazine, a cap storage building, ANFO storage building, and normal utilities, such as roads, water supply systems, sewer system, drainage control and electrical distribution system. Garbage will be trucked to an existing regional disposal site.

21) During the construction phase of the project, a 200-man construction camp will be located adjacent to the plant-site.

22) A 10.5 km. (35 KV) powerline will be constructed from the mine site to the B.C. Hydro Strathcona Power Plant. An additional 35 KV powerline will be built between the plant-site and the various pit areas.

23) The Manager of Engineering concluded his presentation with a description of the coal haulage route, the coal storage and loading facility at Middle Bay, and a project development schedule. The Commission noted that some minor construction alterations will be required to the existing roads, and also that only 10 residences were in existence adjacent to the proposed route along Highway 28. The Commission also noted that the storage facilities for coal at Middle Bay would have a capacity of 7500 M tonnes and would be covered. The loading facilities would be designed to handle approximately 18,000 M tonnes of coal per week.

SURFACE WATER MANAGEMENT

Mr. Norman Guild, P. Eng., from Ker, Priestman and Associates Ltd., the Surface Water Management Consulting Engineers for Quinsam Coal Limited, gave the following testimony at the hearing. Mr. Milner, Manager of Engineering for the Company, testified later that the Company was in agreement with his statements and would carry out the suggestions and recommendations of their Consulting Engineer:

1) A comprehensive surface water management plan has been developed for the Quinsam Project to protect the aquatic environment and to ensure that water quality will be maintained.

2) The maximum use will be made of diversion ditches to convey surface waters around areas of disturbance, thereby minimizing the amount of water affected by the mining operations.

3) All water which will emanate from areas of disturbance will be intercepted by a network of major and minor ditches which will divert it to a settling pond for treatment.

4) At-source controls will be provided to minimize the amount of sediment production and major settling ponds will be constructed downstream to act as a second line of defence.

5) Prior to commencement of construction activities, all related water management systems will be in place.

6) All ditches and treatment facilities will be designed to accommodate the surface water flows from the 1 in 200 year storm event.

7) All project facilities will be located above the 200-year floodplain of the Quinsam River and its tributaries.

8) Total water recycle will be utilized in the coal preparation plant.

9) Preparation plant make-up water will be reclaimed from the plant-site settling pond instead of withdrawing fresh water from the Quinsam River system.

10) All plant-site sewage flows will be treated and discharged through a tile field into the ground.

11) The withdrawal of domestic, fire and emergency plant water requirements will be from Gooseneck Lake, thereby eliminating the need to rely on the Quinsam River system as a water source.

12) A comprehensive surveillance and monitoring program will be implemented throughout the construction and operating phases of the project.

13) The hydrological information and assumptions were stated as follows:

    a) The seasonal precipitation regime is characterized by a dry summer and a wet fall/winter period, with an estimated average annual precipitation of 1185 mm (47"). The rainfall gauge at Strathcona Dam, located 10 km. north-west of the mine-site, and with 14 years of record, is considered to be representative of mine-site conditions, and has been used in the derivation of project design flows, due to its proximity to the study area. The greatest precipitation recorded over 24 hours at the Strathcona gauge is 116.8 mm (4.6").

    b) Based on this information, a hypothetical 10-year storm was synthesized on a model for three areas on the mine-site. The model was calibrated by using information from a run-off of undisturbed ground from Nile Creek, which drains 1500 ha. near Qualicum Beach, and is one of the few gauged catchments on Vancouver Island, and the only small catchment within reasonable proximity to the mine-site. On this basis, the figure for a curve number for undisturbed ground for the Quinsam area was selected at 83. The curve number is a measure of the expected volume of run-off for a given rain event. The model was then used to ascertain the 10-year storm expected run-off from a partially disturbed basin. The curve number selected was 95, which is very conservative. A figure of 98 would be the run-off figure used for pavement.

c) The hydrologic analysis procedure that was followed was based on catch basins not exceeding 500 ha, as any area involved in construction,or a specific mine-site would be less than that area.

d) Pit pumping rates were selected as 2.8 L/s per ha of pit (18 US gpm per acre) which is roughly equivalent to 25% of the 10-year, daily rainfall rate. It should be noted that if pumping rates were less than given above, and if a greater degree of flooding were allowed in the pits, the settling pond capabilities described later in this presentation would be increased.

e) Groundwater inflow rates were determined by Brown (1982) and as these values are in the order of 1/10th of the assumed pit pumping rate, the effect on settling pond design will be insignificant.

f) Unit instantaneous peak flows were assembled by plotting the peak flows from hydrographs developed for catchment areas of varying size. The data was used for the design of the project drainage ditches and culverts.

14) Information on soils, their settling characteristics, suspended solids and flocculants was given, as follows:

a) It was ascertained that the soils of the mine-site area did not exhibit any unusual characteristics and were predominantly derived from a moraine till with a sand to sandy loam texture. The erosion potential is low for these gravelly sandy loams due to their relatively coarse texture.

b) Using site water, slurries were prepared from soil, waste rock and coal samples, and were subjected to a series of laboratory settling tests with and without the aid of flocculants. Test work showed that initial suspended solids concentrations as high as 10,000 mg/L could be reduced to less than 25 mg/L very quickly with the aid of flocculants. In addition, flocculants remained effective at temperatures near 0°C. Supernatants from flocculation tests were sent to B.C. Research for toxicity bioassays, which resulted in fish survival at 100% concentration.

c) The proposed flocculant to be used on the Quinsam site was Calgon 503, or a product with equal or better characteristics, both in settling ability and toxicity.

d) With flocculants, suspended solids concentrations of 10-25 mg/L have been obtained in 4 to 8 hours from initial concentrations of approximately 10,000 mg/L of typical Quinsam soil.

e) The Pollution Control Objectives (Ministry of Environment, 1979) state a range of 25 to 75 mg/L for suspended solids for the discharge of final effluents to marine and fresh waters, and further state that effluents must be non-toxic to salmonids at 80-100% concentrations. Variances may be allowed during periods of excess runoff and it is accepted that floods having a magnitude greater than the 10-year return period constitute "excess runoff".

f) Although there are no specific Federal Government regulations for coal mining, the Metal Mining Liquid Effluent Regulations and Guidelines of the Environmental Protection Service (Fisheries and Environment Canada, 1977) require that the monthly mean total suspended matter concentration not exceed 25 mg/L, and that no single grab sample exceed 50 mg/L. The maximum acceptable concentration in a composite sample is 37.5 mg/L.

g) Quinsam Coal is committeed to meet the Environmental Protection Service's stringent objectives for suspended solids.

15) Typical at-source controls to limit soil erosion and lessen the carry-off of solids in the runoff were stated to be as follows:

a) In-pit sediment traps to reduce solids from mine water before it is pumped to a major settling pond.

b) The design of all man-made drainage collection ditches and culvert installations to minimize erosion.

c) The revegetation of cut, embankment or large graded surfaces at the earliest opportunity.

d) The use of construction and mining techniques which permit retention of disturbed soils at source.

16) Four major settling ponds are proposed for the mine-site, which are as follows:

a) Pond #1 will receive drainage from Pit 1S, Pits 2S - 3S, the south waste dump and their associated haul roads.

b) Ponds #2 and #3 will treat drainage from Pits 4S, 5S and 6S.

c) Pond #4 will service the plant-site area, the north waste dump and Pits 2N and 3N.

17) The four major settling ponds will incorporate the following features:

a) A surface area and live storage volume which, with the aid of flocculants, will treat to required levels the runoff from a 1 in 10-year, 24-hour storm event.

b) A 10-hour detention capability for runoff from the 10-year/24-hour storm in accordance with Provincial regulatory requirements.

c) Multi-cell construction which will permit the pre-settling of the coarser fraction of the suspended solids at the upstream end of the pond.

d) An automatic flocculant station, complete with stand-by diesel generator for back-up electrical power.

e) Outlet works designed to accommodate a 1 in 200-year storm event and provided with suitable trashrack and downstream scour protection.

f) Baffles, as required, to ensure that the trapping efficiency of the pond will not be reduced by short-circuiting or large wave action.

g) A sediment storage volume below the lowest elevation for live storage.

h) Clean-out ramps to permit removal of accumulated sediments for deposition in mined-out pits.

i) From the design hydrographs and the soil characteristics of the mine-site, the settling ponds will require a live storage volume equivalent to 450 m^3 per hectare of partially disturbed catchment, and 270 m^2 of surface area per hectare of catchment, to settle all particles greater than 0.01 mm diameter in 10 hours, naturally.

18) It is estimated that 15% of the suspended solids will be less than 0.01 mm diameter, which will make it necessary to use the aid of flocculants during some periods of the year to meet a 25 mg/L standard.

19) From the Stage II Addendum drawings and Mr. Guild's testimony, the following information is available on the Settling Ponds:

Pond No. 1 - will discharge through a decant structure to a natural water-course and into Long Lake, about halfway along its length. Because of the high degree of flow attenuation which will be achieved in the pond, peak flows will be reduced to approximately 1/6th of their inflow value. The ten-year return period peak flow from the pond will be 0.8 M^3/sec (12,600 U.S. gpm). The pond surface area will be 2.9 ha, the volume 44,000m^3, and the catchment area 150 ha.

Pond No. 2 - will discharge through a decant structure to a short section of excavated channel to the outlet end of Long Lake. This pond will also receive partially treated drainage from Settling Pond No. 3, which will use Pond No. 2

for final flocculated settling. The ten-year return period peak flow from this pond will be 1.4 m^3/sec (22,000 US gpm), the pond surface area will be 4.0 ha, the volume 78,000 m^3 and the catchment area 138 ha.

Pond No. 3 - The discharge from this pond will be flocculated at the outlet and will thereafter pass through Pond No. 2 for final settling before reaching Long Lake. Pond No. 3 will also serve as a preliminary settling pond and as a natural detention basin to retain and attenuate the flow to Pond No. 2 until peak runoff conditions have abated. The ten-year return period peak flow from this pond will be 0.2 m^3/sec (3,000 US gpm), the pond surface area 2.3 ha, the volume 24,000 m^3 and the catchment area 53 ha.

Pond No. 4 - will discharge through a decant structure to a small ravine and then into the north end of Middle Quinsam Lake. This pond will serve as a water source for the preparation plant. The ten-year return period peak flow from the pond will be 2.1 m^3/sec (33,000 US gpm), the pond surface area 6.5 ha, the volume 106,000 m^3, and the catchment area 393 ha.

20) Pond clean-out will only take place during dry weather periods and any pond water which becomes elevated in suspended solids will be confined within the pond and treated prior to release.

21) The surface water management plan developed for Quinsam Coal Ltd. is a flexible plan which can be easily adapted to changing situations. Ponds can be enlarged to accommodate changes in the mine plan, pond hydraulic loadings can be reduced by allowing pumped pit water to be shut off during periods of intense rainfall and treatment capabilities of the ponds can be increased by progressive reclamation.

22) Test work and pond design criteria also suggest that suspended solids levels in releases from the project settling ponds will normally only approach 25 mg/L during periods of high flows in the Quinsam River when suspended solids would usually be elevated.

GROUNDWATER & ACID GENERATION:

Mr. Bill Brown, P. Eng., from Brown, Erdman & Associates Ltd., the Hydrogeology Consulting Engineers for Quinsam Coal Limited, gave the following testimony at the hearing:

1) An evaluation of the "site specific" characteristics of the groundwater geology and hydrology of the proposed new mine-site is a standard requirement of the environmental impact assessment of any new mine. It is necessary to know how much groundwater is moving beneath or through a proposed mine site, in what direction it moves, how fast it moves, and by what means it moves. It is also necessary to know the quality of the groundwater before mining starts. The relation between surface waters and groundwaters must also be known.

2) In June of 1981, the Potential for Acid Generation by the rocks of the mine site area was of concern and the effect such generation, if it indeed did occur, would have on the quality of the groundwater flowing through the rocks of the area. Concerns were also expressed regarding the possible presence of conduits through which groundwater might move more quickly than through ordinary rock and what might happen to the regional groundwater regime if the conduits were disrupted by mine activities.

3) The geology of the Quinsam River from Middle Quinsam Lake to the main bend of the Quinsam River was examined and photographed in detail.

4) A two-phase program was initiated to study the critical areas of the proposed mine.

   Phase 1 (Sites P1, P2 and P3) was a hydrogeological program for drilling and testing in the area of the main meander of the Quinsam River. This meander lies approximately 250 meters downstream from Middle Quinsam Lake. This area lies between the 2N and 5/6S proposed pits.

Phase II (Site P4) was a program conducted in the area between the 2N and 3N proposed pits. This program also included the coring of holes in the 3N, 2N and 4S Pits for the evaluation of the Acid Generating/Consuming Potential of the mine-site. These pits were chosen because they contained the majority of the coal reserves. These holes cored the section of rock and coal to be mined and extended two to four meters below the coal. Holes ranged from fifty-six to sixty-nine meters in depth with a total of 170 meters of hole being cored.

The site exploration consisted of 5 holes, totalling 350 m of drilling, eight piezometers, two screen sets, and a pump test run at 1 x 10^{-3} m^3/sec (13 Igpm) for 4200 minutes with standard water level drawdown and recovery measurements taken and recorded.

Pump tests were also run in two open coal exploration holes in each of the 2/3S and 4S pits.

5) In summary, the following statistics for the whole hydrogeologic program show the extent of the site specific field work conducted by Quinsam Coal Ltd:

Number of holes drilled - 15
Number of piezometers set - 23
Number of screens set - 3
Number of pump tests run - 6
Meters of hole cored - 246
Meters of hole drilled and cored and used for hydrogeologic evaluation - 839
Length of field program (months) - 7

6) The Phase I Program showed that the area involved is underlain as follows:

Description	Thickness
River gravels and boulders	(0 - 3m)
Till	(25 m)
Gravel water-bearing	(almost 5m)
Sandstone, Shale and Coal	(39m)
Volcanics	(1½ m) drilled

7) A pumping test was also carried out on the Phase 1 Program at a rate of 3.4×10^{-4}/sec (4.5 Igpm) for 4140 minutes, which showed the following:

a) The glacial till is essentially impermeable with no response shown in piezometer P1-3-2.

b) The transmissivities of the sand and gravel unaffected by bedrock boundaries is 1.16×10^{-4} m^2/sec (808 USgpd/ft) while those affected by the boundaries average
$4.9 \times 10^{-5} m^2$/sec (338 USgpd/ft).

Storativity values range from 1.7×10^{-4} to 3.6×10^{-5}.

c) A buried river channel cannot be present in the area of the P1 site because bedrock is present in the bed of Quinsam River downstream from the site and because of the elevation of the top of bedrock in P3 and two of the coal exploration holes.

d) Low hydraulic gradients are present at the P1 Site. The gradient in the sand and gravel is 0.015 and in the coal it is 0.017. Therefore, the volume of groundwater flowing towards the north east at the P1 Site is 0.07L/sec (0.92 Igpm)

e) A bowl-shaped depression which extends under Middle Quinsam Lake is present.

8) The Phase II program showed that the area between the proposed 3N & 2N pits was underlain by up to 90 meters of unconsolidated sediments which were made up as follows:

Description:	Thickness:
Till	(up to 50 m thick)
Sand and gravel (water bearing)	(15 m)
Clay	(10 m)
Sand and gravel (water bearing)	(10 m)

9) The Phase II program showed the following:

   a) At the P4-2 Site, erosion has cut out the coal-bearing series and unconsolidated sediments directly overlying volcanics.

   b) Two branching bedrock depressions are present.

   c) Sand and gravel has an unaffected transmissivity of $4.6 \times 10^{-5} m^2/sec$ (320 US gpd/ft) and storativity of 1×10^{-4}.

      Effective parameters are changed by the presence of bedrock to a transmissivity of $1.4 \times 10^{-5} m^2/sec$ (97 US gpd/ft) and a storativity to 5×10^{-5}.

      Safe yield of a well at P4-2 should be $5 \times 10^{-4} m^3/sec$ (6 Igpm).

   d) No recharge boundaries are shown on the drawdown and recovery plots; therefore, no fault and fracture conduits can be present.

   e) The volume of groundwater, flowing along the P4 Site depression is $2.2 \times 10^{-4} m^3/sec$ (3 Igpm). The average velocity of this slight amount of groundwater is equivalent to 2 km in 35 years.

10) There is nothing unusual about the groundwater flows which move through the mine-site. The total existing flow through the site is $1.56 \times 10^{-2} m^3/sec$. (205 Igpm) and the flows through the various pits range from 1×10^{-4} to $8.7 \times 10^{-3} m^3/sec$ (1.3-116 Igpm). Groundwater flowing into each pit has been calculated to range from slightly over 1 gpm for the ultimate 1S pit to almost 300 gpm for the ultimate 2N and 3N pits.

    Groundwater discharge during mining will range upwards to 370 gpm in year 9 and drop back to 158 gpm by year 12.

    It should be noted that these flows are not extracted from the hydrologic system of the mine site area but will be transferred from the groundwater to surface water systems via the mine water management system.

11) From groundwater tests in the mine-site area, the pH ranges from 8.1 to 8.8 and averages 8.4.

12) All groundwater intercepted by the pits will be directed to the water management system where it will be mixed or treated to acceptable limits before released to surface waters.

13) The potential for the rocks proposed to be mined to either consume or produce acid was studied and the results were as follows:

   a) Groundwater sampled for various clients over a twenty-one year period by Brown, Erdman & Associates Ltd. showed groundwaters from rocks along the east coast of Vancouver Island, which are similar to those of the coal-bearing series to be mined by Quinsam Coal, were not seriously acidic and had a pH range of 6.5 to 9.5.

   b) Large amounts of oxygen are required to produce acid from pyrite. It is common knowledge that groundwater contains low levels of oxygen.

   c) Noticeable sections of the sandstones of the coal-bearing series are highly calcareous.

   d) The groundwater gradients will be towards the pits during mining so that any contaminated groundwater will not spread outwards but will flow inwards towards the pits and will be pumped to the water management system.

   e) Preparation plant reject material will be placed close to the pit floor where it will be covered by acid consuming waste rock and buried beneath the groundwater table in a very low oxygen environment.

14) A summary of the results of his study were as follows:

   a) Both rock and unconsolidated deposits have very low hydraulic conductivities.

   b) Groundwater gradients are low.

c) The above two facts combine to show that groundwater flows are extremely slow and that only small amounts of groundwater flows beneath the mine area.

d) For practical purposes, the surface waters in the Quinsam River and the groundwaters in the sands and gravels and in the coal are separated by low permeability till, sandstone and shale.

e) No highly permeable conduits of unconsolidated deposits or faults and fracture zones are present in the mine area.

f) Composite samples of the full section of waste rock and coal that is to be mined and the waste rock that will be returned to the pits have been classified by B.C. Research as non-acid producers, net acid consumers, with clarified leachates non-toxic to fish.

g) Small sections of the rocks to be mined have an acid generating potential. There are ten times more rocks with an acid consuming potential than there are rocks with an acid-generating potential. Any acid that might be produced during mining will be neutralized by alkaline (acid consuming) groundwaters flowing into the pits and by the carbonates in the waste rock.

h) Acid cannot be generated in the abandoned pits because materials capable of such generation will be buried beneath acid consuming waste rock, surrounded by undisturbed rock containing alkaline (acid consuming) groundwater, and will lie in a low-oxygen environment beneath the water table.

Mr. Ab Bruynesteyn, who is the Head of the Division of Extractive Metallurgy at B.C. Research, gave the following evidence to the Commission:

1) He said that his presentation would deal specifically with procedures and techniques developed by the B.C. Research laboratories for predicting acid mine drainage, the reliability of the techniques and the

significance of leach tests.

2) He said that B.C. Research personnel had developed short-term tests for predicting whether exposure of a sulphide mineralization will result in acid mine drainage. This technique had been developed primarily to assess the potential for environmental contamination.

3) Sulphide-bearing minerals, when exposed to the atmosphere, will leach, in many instances producing acidic drainage unless prevented from doing so by environmental constraints. The two most important such constraints are the concentration of iron or other sulphides in the mineralization to be exposed, and the alkalinity (or acid demand) of the host rock. The first step in assessing the potential of any mineralization to produce acid drainage is to determine its sulphide level and its alkalinity; it being assumed that oxygen and water from the atmosphere will be available at the mineral surface.

4) Initial determinations are made chemically by conventional techniques on representative and highly pulverized samples. If acid production is appreciably below acid demand, then no theoretical possibility exists that a pH of 3.5, necessary for microbiological leaching, can be maintained. In short, acid drainage cannot ensue if the mineralization is exposed to the environment. However, if maximum possible acid production exceeds acid demand, then acid drainage could result, and further confirmatory tests are required.

5) In practice, the biological production of sulphuric acid from pyritic or sulphide ores is invariably less than the theoretical maximum calculated on the basis of the sulphur content of the ore. An accurate estimate of the biological acid production can only be made by a biological test. The biological test is normally carried out only if the earlier chemical test indicates leaching as a possibility.

6) When the various stages of a biological test are carried out and the pH remains at 3.5 or below, the original sample portion used in the test has developed enough acidity to permit leaching of the subsequent portions of the same size (i.e. leaching is self-sustaining)

7) Where insufficient acid is produced microbiologically to sustain leaching under laboratory conditions, then virtually little possibility exists that leaching will occur in practical situations. This is because all constraints to microbiological leaching are removed under conditions of the laboratory procedure which is not the case in field situations. If sufficient acid is generated to sustain leaching under laboratory conditions, then leaching may occur in the field, depending on those constraints to microbiological activity which are operative.

8) The reliability of the technique has been verified in a study carried out on behalf of the Federal Environmental Protection Service. Representative samples were tested from 16 different mining operations in Canada. The results were as follows:

    a) Chemical tests indicated 9 operations could produce more acid than the acid demand of the host rock and that 7 could not.

    b) Confirmatory biological tests indicated that only 8 operations could produce sustained acid leaching, and that 8 operations could not.

9) Even though the testing procedure has been confirmed and is now widely used, caution must be exercised in interpreting the results, particularly when the size of the acid producing or consuming rock at the mine-site is large, and, therefore, the surface area available for interaction, small.

10) Laboratory leaching tests can indicate whether an ore body will or will not sustain leaching. If leaching does not occur, then the potential for environmental damage does not merit further consideration in the planning of the mine development. If leaching does occur, then suitable provision can be made for its presence in the mine plan.

In the case of a mine tailing, protective techniques would involve compacting and covering (exclusion of oxygen and water to stop microbiological oxidation), or pre-mixing the tailing before storage with adequate quantities of alkaline materials, usually lime. The latter procedure prevents the development of the acidic pH values essential to the development of microbiological activity. Reliable estimates of the maximum alkalinity, to be added externally as lime, can be developed from results of the laboratory tests.

In the case of non-metal mines, such as coal mines producing sulphide containing wastes, methods of disposal must be adopted that will minimize the contact between the sulphide minerals with water and/or oxygen.

Minimizing contact with water in surface stored sulphide material is difficult, particularly in the early stages of dump development. When possible, the sulphide materials should then be surrounded by alkaline rocks such as calcium carbonate containing wastes. If, despite such precautions, some oxygen and water might penetrate into the sulphide material, the alkaline constituents dissolved into such water from the overlying carbonate waste, will prevent the establishment of an acid condition. When such wastes are disposed of in a location below the water table, only small quantities of oxygen would be available for oxidation. Slowly moving groundwater would not contain more than 10 mg/L dissolved oxygen.

11) The Commission noted that Mr. Bruynesteyn did not draw any conclusions concerning the Quinsam minesite in his evidence-in-chief. He left the results of the B.C. Research tests for Mr. Milner to bring before the Commission.

Mr. Tom Milner, Manager of Engineering for Quinsam Coal Limited, gave the following testimony to the Commission:

1) Initially, as part of the Stage II Submission, five samples of coal and two grab samples of waste rock were tested at B.C. Research. The results of these tests indicated that all the

samples except one coal sample had acid generating potential. The two waste rock samples were grab samples from the 4S and 1S pit area. No interpretation as to their original location in the rock strata or the quantity of materials they represented could be ascertained.

2) The results of these initial tests appeared to be in contradiction to the findings of the Brown Erdman & Associates Ltd. study which observed that the sandstone and shale on the mine-site were significantly calcareous in nature, and that the groundwater in the area had a high pH in the range of 8.2 and 8.8

3) As a result, and as part of the Stage II Addendum work, it was decided to drill three cored holes in the middle of the 3N, 2N and 4S pits Full section of core,including coal and partial sections representative of the major sandstone and shale series, were analyzed and tested at B.C. Research for acid generating potential. All sections of core representative of material within these pit boundaries were found to have no acid generating potential with $CaCO_3$ equivalent to sulphur ratios from 5.12 to 11.30. These ratios are well above the 3.125 ratio, below which the material might become acid producing. A total of sixteen representative sections from the three holes were analyzed and tested during this evaluation.

4) The conclusions drawn from these new samples were as follows:

    a) Majority of waste rock to be mined is acid-consuming rather than acid generating.

    b) Certain parts of shales associated with the coal seams could have acid generating potential. This material was estimated at 6% of total material mined. In addition, preparation plant rejects were assumed to have acid generating potential and represent about 2% of total material mined.

    c) The normal mining sequence is such that the materials with acid generating potential will be placed near the bottom of the backfilled pits where they will be covered with acid-consuming sandstone and shales. The majority of this material will be beneath the water-table in the post mining situation.

5) After the filing of the Stage II Addendum, another seven holes were drilled in the 3N and 2-3S pits to obtain coal samples representative of the first five years of the coal to be mined. Samples of the cuttings from the waste rock at various intervals ranging from 5 to 10 feet were collected. These samples were composited in the same manner as was done in the Stage II Addendum work, so as to have a direct comparison with those results. In addition to these samples, an additional 35 samples of core material adjacent to the No. 2 and No. 1 seams in the 3N and 2-3S pits were also logged and analyzed to further determine the base to acid ratio.

   The results confirm that the overall column of material to be mined has high $CaCO_3$/S ratios as was identified in the Stage II Addendum.

   The remaining cores from the three holes that were drilled as part of the Stage II Addendum investigation were described in detail. This was followed up by sampling and chemical analysis of the various pertinent geological horizons defined by the geological logs to determine base to acid ratios.

   The majority of acid generating potential material is associated with the No. 2 seam roof and the No. 2 Rider Seam. As can be seen from the acid-base account, the material associated with each seam is approximately 2 metres.

   It should be noted that the interburden between No. 2 and No. 1 seam is very low in sulphur, at less than 0.1% total sulphur.

6) The interpretation of all the exploratory work done in connection with acid generation potential in Pits 3N, 2N and 2-3S, is that the average amount of acid generating potential material to total volume of pit material is 8.6%.

7) The remaining pits 4S, 5S and 6S will not have any mining activity before 1991 to 1996, and have not been analyzed in detail. It is expected

that the material in these pits will not differ appreciably from the material in Pits 3N, 2N and 2-3S. Confirmatory testing will take place in Pits 4-S, 5-S & 6-S long before mining commences, and the results from these tests will be incorporated into a detailed mine plan.

8) Mine plans have been developed such that the material with acid generating potential will be placed near the bottom of the mined out pits and the majority of this material will be beneath the groundwater in the post-mining situation. Preparation plant rejects will also be deposited near the bottom of the mined out pits. It should also be noted that during the course of the mining operations, there will be some mixing of the calcareous material with the acid generating material.

9) The initial mining of the Pits 1S, 2-3S will have to allow for placing of a minimal amount of material with acid generating potential in the out-of-pit dump during the pre-production mining phase. This material will be placed in the dump and totally surrounded by acid consuming rocks. As will be outlined in the reclamation plan, this dump will be reclaimed during the initial few years of mining.

   During pre-production mining in the south pit, an area within the pit will be prepared for backfilled preparation plant rejects for the first year of coal production. After the first year, all coal propara-tion plant rejects will be disposed of in the back-filled dragline north pits.

10) In summary the following Management Practices will be implemented to preclude the formation of acid mine drainage.

    a) Detailed physical and chemical analysis of representative core will be carried out on an ongoing basis.

    b) Mining operations will place the material with acid generating potential, including preparation plant rejects, near the pit bottom.

    c) The mining operation will place acid consuming materials on pit floors and against pit walls. As was pointed out previously, pit floor materials are acid consuming.

d) The afore-mentioned practices will ensure that the material with acid-generating potential will be placed so that they are surrounded by acid-consuming material. Also,the majority of the material will be beneath the water table in the post-mining situation.

e) Till and topsoil will be placed on backfilled pits within a few years and vegetation growth will be quickly established. This will be outlined in detail in Mr. Polster's presentation on reclamation.

11) While acid drainage will not occur, we have developed acid contingency plans to treat any acid drainage before it leaves the open pit. A simple, inexpensive lime addition water circulation system in the pit sump can be installed. This system can be set up within 24 hours.

Mr. Andrew Sobek, of Engineers International Inc., Chicago, Illinois, U.S.A., gave the following testimony to the Commission:

1) He said that he was an authority in the United States on acid mine drainage. He indicated that he had some 30 years of experience in this and related fields of endeavour. He told the Commission of some 13 significant geochemical assignments which he had completed for industry and government in the course of his career, and that he had also published some 42 technical documents in his field of expertise.

2) He told the Commission that he had been hired by the Company to make an over-all assessment of the acid-generating potential of the mining operations, as described in the Company's presentation.

3) Since Mr. Sobek's presentation is relatively short, it is hereby given in full.

INTRODUCTION:

Acid generation in surface mines requires a source of sulphide minerals, moisture and oxygen. To accelerate the reaction, iron and sulphur-loving bacteria present in the atmosphere will grow in large populations when the conditions surrounding the active materials (sulphides) are optimum. This process, important as it is, remains only one component of acid mine drainage.

Acid mine drainage (AMD) defined by the U.S. Environmental Protection Agency is "any acidic water draining or flowing on, or having drainage or flow off any area of land affected by mining". Therefore, water is the second important component of AMD.

Water from groundwater, surface water and precipitation removes acid-sulphate salts from the reactive surfaces of sulphide minerals providing clean surfaces for the reaction to continue and movement of acidic waters away from the spot of acid generation. Thus, the second part of AMD is accomplished.

The third important component of AMD is management. Management of the total mining system can be viewed as a catalyst like the bacteria are to the sulphide oxidation process or as a major component of AMD. The latter view is gaining in popularity in most major coal producing areas of the world.

Total management of the mining process include water control, overburden handling procedures, reclamation plans, and environmental impact amelioration scenarios integrated in the total mining operations system. This component of AMD is the most important factor of AMD when mining occurs in environmentally sensitive areas.

OVERBURDEN ANALYSES:

The analyses in the Stage II Addendum were on composited samples that had been described by dominant lithology. These data were developed using B.C. Research's biological acid generation test and indicate no acid generating potential. Confirming analytical work done in 1983 provides cross sections of pits 3N, 2N and 2-3S that show lithologic sequence continuity.

Acid-base balances were developed for two cores in pit 3N and one core in pit 2N. These data confirmed earlier conclusions concerning the overwhelming amount of carbonates present in the overburden rock. In addition, a small zone of material above and below the No. 2 coal seam was found to be potentially acid generating. Further confirmatory tests showed that this potential acid generating zone was consistent across the mine-site when the No. 2 coal seam was present. The ongoing confirmatory work includes the development of detailed acid-base balances for pit 2-3S.

LABORATORY ANALYTICAL PROCEDURES:

The analytical procedures used to develop the acid potential part of the acid-base balances were classical wet-chemistry techniques that are quite reliable. However, they give higher results compared to the sulphur furnace technique that is commonly used for determining sulphur in overburden rock. Secondly, the cold acidity method for determining carbonate content (the base part of the acid-base balance) give low results compared with the hot acid technique that gives a measure of total neutralizers present in the rock. Maintaining the most conservative approach, as Quinsam has done, in developing the acid-base balance provides a safety margin when using the overburden data to predict that AMD will not occur.

HYDROLOGY:

The conclusions of the Brown Erdman & Associates Ltd. report indicate that the groundwater characteristics of the bedrock control the groundwater hydrology of the mine-site area and the permeability and hydrologic gradients are extremely low. Groundwater, therefore, will not cause large volumes of water to flow into pit area during the mining phase. The groundwater is alkaline (acid consuming) and has a high buffering capacity as evidenced by the pH ranging from 8.1 to 8.8, high titrateable alkalinity, high total dissolved solids, and high conductivity measurements. Water quality data in Table 3.1.6-2 of the Stage II Addendum report indicated all wells sampled had alkaline waters that were highly buffered.

MINING METHOD:

The method that will be employed at the Quinsam mine will be flexible enough to successfully accomplish the material handling procedures stated in the Stage II Addendum, and as previously outlined by Mr. Milner.

During the first year of mining operation, a dump in the south mine area will be built. Acid generating overburden rock will be buried and completely surrounded by carbonate-rich materials to inhibit acid generation and neutralize any acid that may form. After the first year, mining will progress to a point where potentially acid generating materials plus coal preparation refuse will be buried in the pit above the water table and surrounded by acid consuming materials. This burial method will only exist for a short period of time until mining operations advance to a level where the water table will return after mining has been completed. Then the placement of potentially acid generating materials will be under the future water table.

Water control during mining will be complete with ditches diverting surface runoff away from the pit and catching any seepage from the dumps. This water plus the groundwater will be diverted into the settling ponds before being discharged from the property.

SUMMARY:

After reviewing the major areas of concern that pertain to the AMD question, the following conclusions can be drawn:

1) The geochemical data combined with detailed lithologic core descriptions indicate an overwhelming abundance of acid consuming materials in the overburden rock.

2) Considering the Company took a conservative approach,utilizing the wet chemistry methods of analysis, conclusion No. 1,above, is even more meaningful.

3) Highly alkaline groundwater flowing through potentially acid generating materials and neutral rainwater percolating down through high alkaline rock materials, will inhibit any acid production by the buried potentially acid-generating materials because reactive surfaces will become coated with carbonates and/or acid-sulphate salts will be neutralized by the high alkaline water.

4) If there would be any acid generated during mining, AMD by definition would not occur because there is total water control of both surface and groundwater. Any acid seep in the pit would be treated before being pumped to the settling pond.

5) As more confirming evidence becomes available, it will provide additional insight to the geochemical character of pits 4S and 5-6S. Because these areas are not to be opened until 1991, the mining plan can be modified easily to account for any localized zone of potentially acid generating materials.

6) No AMD problems will occur provided that Quinsam implements their management practices, as outlined in the Stage II Addendum and Mr. Milner's presentation.

WATER QUALITY, NUTRIENTS & FISHERIES:

Dr. Jim Malick, Ph.D., of Norecol Environmental Consultants Ltd., gave the Commission the following testimony:

1) He said that he was the Head of Aquatic Sciences, Norecol Environmental Consultants Ltd., and that he had obtained his Doctorate in the fields of limnology and fisheries. He told the Commission of some 15 significant assignments which he had completed for Industry and Government in limnology, water quality and fisheries over the course of his career, and that he had also taught courses in the fields of ichthyology and aquatic ecology at university level and given many technical papers to scientific organizations.

2) He told the Commission that he and his organization had been hired by the Company to carry out studies, including evaluation and reporting on water quality and limnology of the mine-site area, along with preparation of the Stage II Addendum, Volumes 1 & 2.

3) He described the existing water quality as "that of a virtually undisturbed natural system with low concentrations of dissolved and total solids, and low turbidity and conductivity values. The pH of the water is near neutral with low values for alkalinity and acidity, indicating a very low buffering capacity for the system".

4) Streams and lakes were well oxygenated. Other water quality constituents including nutrients were generally low in concentration.

5) Water quality modelling studies were carried out and presented in the Stage II Addendum. The results of these studies indicated that the mine would cause an increase in nitrogen concentrations in surface water in the vicinity of the mine, but also indicated limited change in algal growth. The conclusion being that a local effect on biota composition and productivity will probably occur. Maximum nutrient concentrations, however, did not approach levels considered unacceptable in public water supplies, or toxic to aquatic organisms. The study indicated that nutrient levels were not likely to be excessive and may, in fact, enhance fisheries resources as a result

of increased primary and secondary production. The increased production capability was not expected to lead to nuisance algal blooms.

6) Subsequent to the Stage II Addendum submission, additional water quality and biological sampling and analyses have been conducted. In addition, more detailed nutrient modeling has been carried out for Middle Quinsam and Long Lakes. These further analyses were conducted to both confirm the earlier predictions of nutrient influences and provide baseline data for future reference.

   Results of the additional sampling confirm the assessment of nutrients presented in the Stage II Addendum. These additional studies show that primary production within the Quinsam drainage is low and limited by availability of nutrients. Levels of available nitrogen and phosphorus are both low in surface waters and indications are that phosphorus is the limiting nutrient.

   If additional nitrogen were added to the Quinsam system, as indicated in the Stage II Addendum, the result would be a limited increase in algal production. This would be the case whether phosphorus or nitrogen is currently limited because available levels of both of these nutrients are low.

7) Dr. Malick then went on to outline and explain the limiting nutrient or element concept, which was as follows:

> As part of this presentation, I would like to outline the limiting nutrient or element concept. In order for algae to grow and reproduce,certain elements are required. Given a specified set of conditions such as light, water temperature and available elements, it may be expected that an algal community will develop. As this community grows and reproduces, it utilizes available elements to the point where one or more elements are in relatively scarce supply for the requirements of the plants. Thus, production slows, having reached this threshold level for the given element or nutrient. In this way, the production of the community and perhaps the system is limited by the concentration or amount of the essential element. Documentation

of the make-up of the algal community and ratios of elements in the water column or within algal tissue can be useful in determining which element may be limiting production within a system.

8) On this basis, the following nutrient studies were carried out:

   a) Tissue nitrogen and phosphorus determinations for stream periphyton and lake phytoplankton.

   b) Analysis of water samples for nitrogen and phosphorus.

   c) Periphyton and Phytoplankton community composition.

   d) Artificial substrate stream periphyton growth studies and computer modeling studies.

9) Other information on general water quality, algal and zooplankton tissue metals, zooplankton community composition and benthic invertebrates are also being gathered.

10) Results of the water quality sampling show that pH of surface water ranges from about 6.5 to 8.0. Total alkalinity is low, ranging between about 18 and 50 mg. $CaCO_3$/liter. Hardness is also relatively low extending over the same range of alkalinity (i.e. 18 to 50 mg. $CaCO_3$/liter). Metal concentrations were always low, usually being below detection limits with the exception of aluminum and iron.

11) Nutrient concentrations were low throughout the whole drainage system. Of particular interest, the concentration of phosphorus in the lakes were as follows:

   a) Total phosphorus -ranged from less than 0.003 to 0.016 mg/liter
   b) Dissolved phosphorus - ranged from less than 0.003 to 0.010 mg/liter
   c) Orthophosphate - ranged from less than 0.003 to 0.009 mg/liter

The lower phosphorus values occurred during the summer growing period, and the higher values occurred in the spring. Most phosphorus values in the streams were also about the same magnitude or less.

12) The concentrations of nitrogen in the lakes, except for Kjeldahl nitrogen (TKN), were usually below detection limits. The highest nitrogen concentrations were as follows:

a) TKN - 0.15 mgN/liter
b) Nitrate - 0.022 mgN/liter
c) Nitrite - 0.004 mgN/liter
d) Free Ammonia - 0.070 mgN/liter

Concentrations of nitrogen as TKN usually increase in the summer, but no pattern was discernible for the other forms of nitrogen. The nitrogen values in the streams were considerably less.

13) Algal tissue nitrogen and phosphorus levels were measured in periphyton and phytoplankton. Nitrogen and phosphorus concentrations in algal tissue were set out in a table presented to the Commission. The values indicate that these nutrients are scarce in the environment. Tissue levels of nitrogen and phosphorus indicating extreme nutrient deficiency in the environment have been shown to be less than 40 µg N/mg and less than 6 µg P/mg, both expressed as dry weight of algal tissue (Healey, 1975). The algal N:P ratios found in the Quinsam drainage were above the optimal ratio in 77-85% of all collections. These data point out that in most situations, phosphorus is at or below optimal levels and is, therefore, considered the limiting nutrient in the Quinsam drainage.

14) In connection with the identification of the periphyton and phytoplankton communities in the lakes and streams, he made the following comments:

a) The periphyton algal community in the river above and below Middle Quinsam Lake and the outlet of Long Lake indicate a range of 35 to 98 percent diatoms, 1.0 to 50 percent green algae and 2.0 to 20 percent blue-green algae.

b) The phytoplankton identification and abundance measurements in the lakes indicated very low production. The phytoplankton communities were dominated by small algae, primarily chrysophytes,although diatoms and cryptophytes became more abundant as the growing season progressed.

15) Dr. Malick said that he had carried out computer ecosystem simulation modeling studies of the effects of the mine operations, in connection with nutrients, on Middle Quinsam and Long Lakes. The model was a Mini-Cleaner Model, which was a sophisticated device with a long history of development, and represents the results of over 35 man-years of effort involving a variety of disciplines.

The Mini-Cleaner Model is specifically designed as a diagnostic tool to investigate the effects of nutrient enrichment and other perturbations on lake ecosystems.

Nitrogen loadings from explosive use in a first scenario were determined, using a 1% and 6% loss rate (Pommen, 1983)for ANFO and slurry explosives, respectively. A second scenario was evaluated using a 3% loss rate rather than a 6% loss rate for slurry explosives. Total explosive use was determined from the projected volume of mined material by each pit on an annual basis. A ratio of 90% ANFO/10% slurry was used in the determination of nitrogen losses.

Flow rates for each settling pond were determined using a water balance table for the year October 1981 - September 1982. Nutrient loadings ($gm/m^3/day$) were input to the lakes as point sources on an average monthly basis. Pommen's (1983) results for another B.C. mine showed that loadings were correlated to flow; therefore, yearly loadings were divided into monthly values based on a percentage of flow for the particular month. Sediment loadings were also assessed and input to the lakes as point sources. Sediment is handled within the model by a sedimentation routine which controls the amount of sediment moving from segment to segment based on the density and shape of the particle and the relative thermal resistance to mixing due to temperature differences of inflow and lake water. Data from settling tests on till, rock and coal samples, as shown by Ker, Priestman and Associates Ltd. (1982) were used in the sedimentation component of the model. Mining year 10 was used as representative of mining operations, based on nitrogen loadings and degree of development of the various pits.

16) Results of the modeling of Middle Quinsam Lake show that production of phytoplankton, zooplankton and fish will be virtually unchanged by the addition of nitrogen from the high loss rate scenario.

Using the 1% to 6% nitrogen loss rate scenario, and the 1% to 3% nitrogen loss rate scenario, the predicted levels of nitrogen in Middle Quinsam and Long Lakes are well within drinking water standards, and far below levels of concern to aquatic organisms.

17) Dr. Malick also noted that studies at another B.C. coal mine indicated that nitrogen losses of between 20 to 60 percent could be expected in settling ponds devoid of macrophytes (Pommen 1983). He noted also that the Quinsam proposal includes the establishment of macrophytes in the settling ponds, which will enhance the uptake of nutrients within the ponds.

18) Consideration of contingencies for nitrogen removal from mine site water is not required in light of recent nutrient information. However, this area is under consideration in response to Government requests and as a result of Quinsam Coal's commitment to environmental protection.

Biological control of nutrients in mine site water could entail either the growth and harvest of aquatic macrophytes in the settling ponds, the irrigation of surrounding forest areas, or a combination of these methods.

19) Dr. Malick's conclusions to his studies were as follows:

> The findings of the water quality and biological sampling programs indicate that the waters of the

Quinsam River drainage in the vicinity of the mine site are representative of an oligotrophic system. Nutrient levels, both nitrogen and phosphorus, were low throughout the period of study and were within the range of values considered ultra-oligotrophic to oligo-mesotrophic. Algae communities are those considered common in oligotrophic lakes and streams.

A few studies have been carried out in nearby eastern Vancouver Island drainages where forest fertilization,using nitrogen,occurred. These studies were conducted at Beavertail Lake (EVS Consultants Ltd. 1982), Mohun Lake (J. Stockner, pers. comm), and the City of Nanaimo water supply reservoir (A. Birkbeck, pers.comm.). In each case, the results indicated a small biological response by a limited increase in phytoplankton growth. In the Mohun Lake study, it was hypothesized that as nitrogen availability increased, phosphorus became depleted, thereby causing a limitation in algal growth capability.

The 1983 baseline water quality data from the Quinsam drainage show that available nitrogen is low at all times and that available phosphorus is low during the summer growing season. Concentrations of nitrogen and phosphorus in algal cells indicated low available nutrient concentrations in the environment. Nitrogen to phosphorus ratios in tissues of periphyton and phytoplankton algae usually indicated phosphorus limitation. These factors combine to show that nutrient levels are low and that the optimum ratio of nitrogen to phosphorus for algal growth is usually exceeded, i.e. more nitrogen is available than necessary for the amount of available phosphorus.

Considering the results of studies on Vancouver Island where nitrogen was added to lakes, the low nutrient availability in the Quinsam surface waters, and the phosphorus limitation of algal growth, it may be concluded that nitrogen addition to the Quinsam drainage would have limited effect on algal growth. It would be expected that some increase in algal production would occur but that phosphorus limitation would prevent substantial increases in algal growth. The effect on the surface waters in the drainage would, therefore, be an elevation in levels of primary production but production would remain within the oligotrophic

> level. Results of these latest investigations confirm that no appreciable changes in productivity will result from the mine development and that water quality for drinking and biological resources will be protected.

Mr. D.B. Lister, Senior Biologist from D.B. Lister and Associates Ltd., gave the Commission the following testimony:

1) He said he had a B.Sc. in Zoology and one year of graduate studies in the Institute of Fisheries, University of British Columbia.

2) He said that his 21 years of work experience has included 14 years as a biologist with the Department of Fisheries and Oceans Canada on both the Pacific and Atlantic coasts, and 7 years as a consulting biologist. From 1962 to 1968, he was responsible for the operation and evaluation of the Big Qualicum River Salmonid Enhancement Project, Puntledge River chinook salmon spawning channel, chinook and coho salmon studies on the Cowichan River and other systems, and the initial planning of a salmon hatchery program for southern British Columbia. During 1969 to 1976, I was senior biologist with the Fisheries and Oceans Canada, Maritime Region, Halifax. I was Head of the Freshwater and Anadromous Fishery Management Section, acting as the senior advisor on management of Atlantic salmon and other anadromous and freshwater species, chairman of three salmon management advisory committees in New Brunswick, and responsible for operation of twelve salmon and trout hatcheries. Since 1976, I have worked in British Columbia as a consulting fishery biologist.

3) He also told the Commission of some 15 significant assignments which he had completed for Industry and Government in his field of endeavour since becoming a consulting biologist.

4) He told the Commission he had been engaged by the Company as an adviser on fisheries resources as they related to the Quinsam Coal Project. This had included involvement in the development and implementation of a baseline monitoring program.

5) Since Mr. Lister's presentation is relatively short, it is hereby given in full:

Background:

The Quinsam River system supports all five Pacific salmon species, as well as populations of steelhead trout and both anadromous and freshwater-resident stocks of coastal cutthroat trout. Average annual salmon escapements to the Quinsam River during the 1971-1980 period are estimated at 153 chinook, 9,300 coho, 616 chum, 11,746 pink and 52 sockeye (Marshall et al 1977 and unpublished Fisheries and Oceans Canada data). Coho and chinook salmon escapements increased significantly during this period to respective levels of 34,119 (includes 11,720 Jacks) and 2,032 (includes 8 Jacks) fish in 1982 (G. Blackmun pers. comm.). The steelhead trout escapement from natural production approximates 450 fish per year (Fisheries and Oceans Canada, 1981).

Chinook, chum and pink salmon spawn in the lower 12 km of the Quinsam River, downstream of cataracts situated below the Elk River timber road bridge. Coho salmon, steelhead and anadromous cutthroat trout spawn and rear in the main Quinsam River up to an impassable falls below Middle Quinsam Lake, 38 km. from the river mouth, and also utilize the lower 2.5 km of the Iron River tributary. Stream areas upstream of obstructions to migration, but below the B.C. Hydro diversion, in the vicinity of Middle Quinsam Lake and the upper Iron River, have also been used to enhance coho and steelhead smolt production since 1978 through stocking of juveniles reared at the Quinsam Hatchery (W. McLean, G. Blackmun and R. Hooton, pers. comm). In the 4-year period 1979 to 1982, coho smolts from this headwater stocking program accounted for approximately 44% of the total coho smolt emigration past the enumeration facility at Quinsam Hatchery (G.Blackmun pers.comm).

Quinsam Hatchery, situated at the confluence of Cold Creek and the Quinsam River, began operation in 1974. It produces approximately 4.1 million juvenile chinook, coho and pink salmon and steelhead trout annually. In addition to direct releases of seaward migrating juveniles, the hatchery also produces juvenile coho and steelhead for planting upstream of obstructions in the Quinsam River system and steelhead smolts for enhancement projects on other Vancouver Island streams such as the Salmon River at Kelsey Bay. Though Cold Creek is the principal hatchery water source, Quinsam River water is utilized for temperature control and as a supplementary source during peak water demand in the spring. The hatchery's reliance on Quinsam River water will increase if current plans for expansion are implemented.

Toxicity Testing:

Settling tests were carried out with flocculants to accelerate the settlement of suspended solids. Suspended sediment samples from till, rock and coal in the mine area were exposed to ten different flocculants in order to identify those most effective in lowering suspended solids levels to 25 mg/l or less in the settling pond discharge. Two of the more effective flocculants were then compared with respect to toxicity to fish. Review of the technical literature indicated one of these flocculants to be 53 times less toxic to salmonid fish than the other. The least toxic of these flocculants is at this time the preferred settling agent for use at the Quinsam Coal operation.

During mine operation, settling pond outflows should not be toxic to fish, as flocculants bind readily with particulate suspended material and their addition to the settling system will be automatically controlled to ensure that they do not exceed the levels required for sediment settling. Bioassays conducted to test this conclusion, using supernatant from flocculant-treated mixtures of water and sediment, indicated that settling pond outflows would be non-toxic to salmonid fish (Quinsam Coal Limited, 1982) The toxicity of waste rock leachates to fish was also tested by 96-hour bioassays with rainbow trout. Fish survival was 100% in all tests (Quinsam Coal Limited, 1982).

Recent Studies:

Since the Stage II submission, additional fisheries and biological studies have been undertaken. Fisheries studies in 1983 are reported in the "Quinsam Coal Project Fisheries Studies - Progress Data Report". Fish were captured in lakes and streams of the study area and marked or tagged for future recapture. Approximately 1,000 fish were captured, processed and released alive during the June-July sampling period. Additional fish sampling was undertaken in late August - early September of this year.

The fisheries investigations show that during the June-July period, coho juveniles were primarily restricted to the lakes. Steelhead juveniles occurred in both lakes and streams but were more common at stream sites. Cutthroat trout were common in both lakes and streams. Stream populations of cutthroat were mainly young-of-the-year, while lake populations included yearlings and older trout. Cutthroat comprised 93% of the salmonids sampled in streams and 64% of the salmonid catches in lakes of the upper Quinsam system. Residual juvenile coho salmon were also relatively abundant in the lakes, making up 24% of the fish catch.

Quantitative fish population and biomass estimates were made at all stream sites. Numbers of fish in streams ranged from about 0.5 to 1 fish/m^2, and biomass ranged from 0.5 to 2.1 gm/m^2.

Information obtained in the June-July sampling indicates that cutthroat trout spawning occurs in the vicinity of the six stream sites studied, particularly the outlets of Middle Quinsam, Long and No Name Lakes, and the Quinsam River upstream of Middle Quinsam Lake. Emerging trout fry appear to rear in the streams for the summer period before moving to the lakes where they spend their subsequent summers.

Conclusions:

The recent baseline monitoring studies of salmonid fish confirm that resident cutthroat trout spawn and rear in the mine area streams and lakes, and that stocked juveniles of the anadromous species, coho salmon and steelhead trout, rear extensively in this area as well. These species are considered to be sensitive to changes in water quality. Considering the conclusions relating to water quality in Dr. Malick's presentation, increases in nitrogen in the upper Quinsam River system are not expected to have any measurable impact on salmonid fish populations, either in the mine area or downstream of Middle Quinsam Lake. Likewise, the 25 mg/l limit established for suspended solids discharges from the mine is considered to be conservative and to afford a high level of protection to the aquatic environment (EIFAC, 1964, Thurston et al 1979). Present mine plans include measures such as pit and haul road relocations, and restricted seasonal timing on bridge construction on the upper Quinsam River, to avoid disturbance of fish habitat.

BASELINE MONITORING, SUPERVISION & SURVEILLANCE INCLUDING BONDING

Baseline Monitoring

Mr. Milner, Manager of Engineering for Quinsam Coal Limited, gave the Commission the following testimony:

1) One of the conditions of the Stage II Approval-in-Principle is that Quinsam Coal Limited undertake the development and implementation of an environmental baseline and monitoring program.

2) The requirements of this program were to be specified by a special provincial-federal sub-committee called the Monitoring Program Technical Committee (MPTC).

3) The prime reason for the program is to collect sufficient baseline data to allow identification and quantification of changes, should they occur with development of the project.

4) The program will measure any significant environmental effects or changes that develop because of the project. The program has been developed in close consultation with scientists in the Provincial and Federal Governments to ensure that the studies proposed and data collected will be meaningful in terms of the overall monitoring objectives.

5) The MPTC has given the Company agreement-in-principle for the program as it now stands.

Dr. J. Malick, Ph.D., of Norecol Environmental Consultants Ltd., gave the Commission the following testimony:

1) The general approach the Company and MPTC have taken in developing the program was to concentrate on characteristics or levels of organisms within the food web that would react most quickly and with the least ambiguity to potential impacts of the mine development. Those study components that would allow earliest detection of impacts on the aquatic environment, therefore, were afforded a primary emphasis.

The program rationale is based on the premise that potential effects of mine development will be seen initially and to the greatest degree within the immediate area of the development. Further, detectable changes would first be noticeable in water quality and the lower food web organisms which have short life cycles and which are sensitive to changes in water quality and thus would respond more quickly to changes in the environment. Organisms at the top of the aquatic food web, such as fish, live longer and would not react as quickly to environmental changes.

2) Another consideration in program development was the variability associated with different subjects of study.

For instance, benthic organisms and fish have a high degree of variability associated with sampling. These areas have been recognized as important but it is difficult to obtain reliable information. For this reason, these parts of the program have been restricted to key locations where intensive sampling would take place. Other characteristics that will provide quantifiable early detection of change will be sampled intensively on a broader scale than those components more difficult to quantify or less likely to respond quickly to environmental changes. This approach offers the opportunity for the collection of the most useful reliable information.

3) The study area is defined as the general area between the B.C. Hydro diversion upstream of the proposed mine to the falls downstream of Middle Quinsam Lake. This is the area that has the potential of being directly affected by mine development. Other locations to be sampled include Quinsam Lake, Iron River, Quinsam River above the Iron River, Quinsam River above Quinsam Lake, and a control lake, Gooseneck Lake.

4) The Quinsam drainage area is affected by man and natural physical features in a way which makes it difficult to identify suitable study sites. Fisheries resources throughout the three parts of the Quinsam drainage are different. In the upper reaches of the Quinsam, there are no salmon; in the middle Quinsam Lake, young coho salmon and

steelhead are stocked, but there is no access to adult fish, and downstream of the falls below Middle Quinsam Lake, salmon and steelhead occur naturally. Also, in addition to these biological differences, the three sections of the drainage area are affected by man by way of forest harvesting, fertilization, commercial and recreational exploitation of the fishery, and enhancement of the area by the hatchery.

5) It was determined that several different types of controls are necessary for the monitoring program. Upstream-downstream sites were selected as controls for water quality and periphyton. A control lake, Gooseneck Lake, was identified for Middle Quinsam and Long Lakes, and it was necessary to rely on baseline stream fish data for later comparison.

Study components were selected for their annual repeatability, reliability as detectors of change, cost effectiveness, and for being the least influenced by minor changes in techniques. The study components selected,items to be measured, sample timing, and frequency, are outlined in the "Baseline Data Collection and Monitoring Program for Quinsam Coal Limited", dated August 4,1983. (This document is filed along with all other submissions to the Commission in the office of the Environmental Appeal Board).

General location of study sites for baseline data collection is shown in Figure 7, Page 72, including Gooseneck Lake as control for Long and Middle Quinsam Lakes. Timing of individual components is shown in Figure 8, Page 73.

Baseline data collection began in January, 1983, and will continue through mid-1984. The results of the studies to date are discussed in the Water Quality, Nutrients and Fisheries Resources presentation.

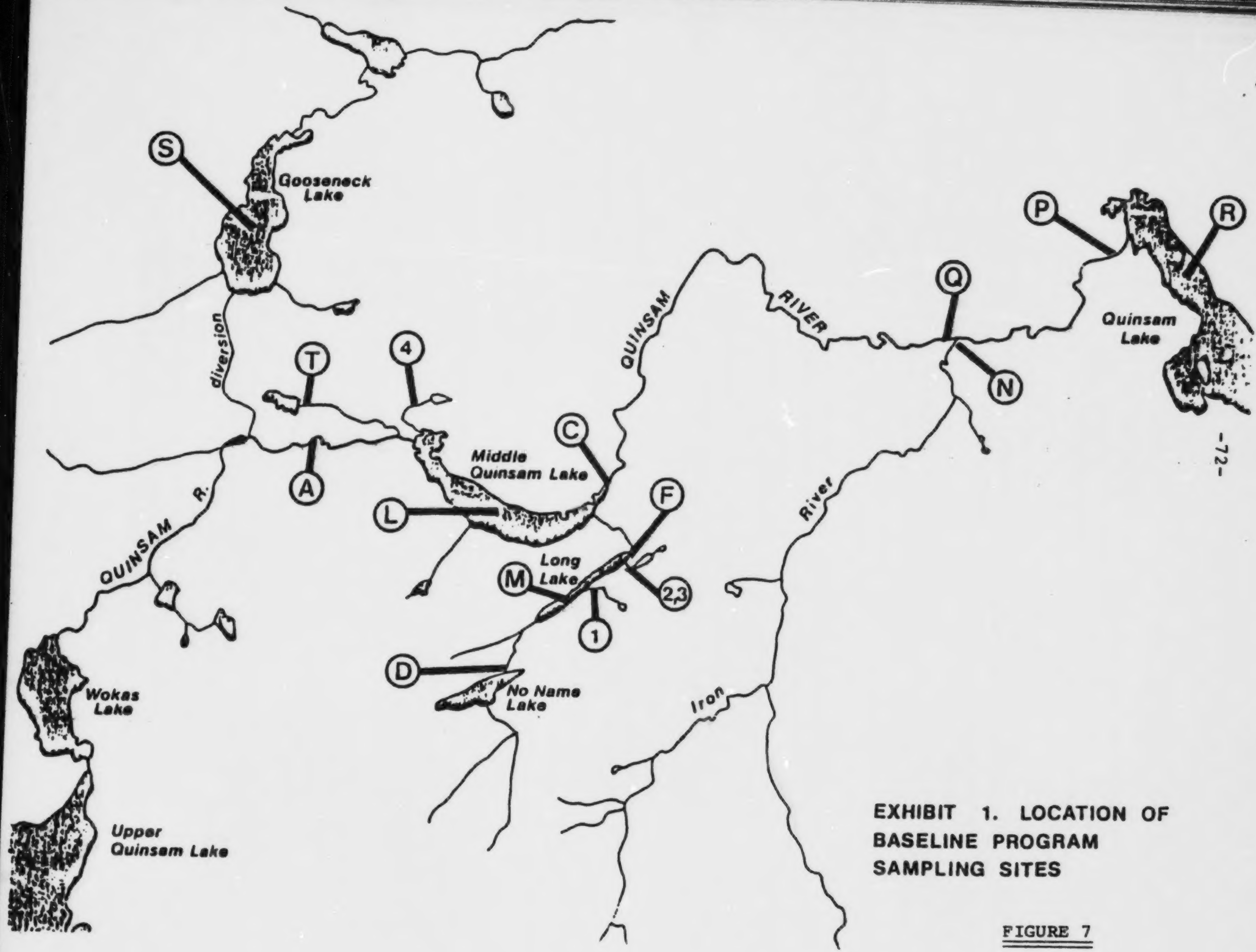

S
Gooseneck Lake
diversion
T
4
A
QUINSAM R.
Wokas Lake
Upper Quinsam Lake
Middle Quinsam Lake
L
C
F
Long Lake
M
2,3
1
D
No Name Lake
QUINSAM
RIVER
River
Iron
Q
N
P
R
Quinsam Lake

EXHIBIT 1. LOCATION OF BASELINE PROGRAM SAMPLING SITES

FIGURE 7

	1983												1984						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
WATER QUALITY	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
FISHERIES and BENTHOS						●	●	●	●						●	●		●	●
PLANKTON and PERIPHYTON					●	●	●	●	●	●	●	●		●		●	●	●	●
HYDROLOGY			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

EXHIBIT 2. QUINSAM COAL BASELINE MONITORING PROGRAM SCHEDULE

FIGURE 8

Surveillance & Supervision Program

Mr. Milner, Manager of Engineering for Quinsam Coal Limited, gave the Commission the following testimony:

1) The Surveillance & Supervision Program is a joint program with the Provincial Government to oversee the planning, construction, operational and abandonment phases of the Quinsam Coal Development.

2) The program involves regular field inspection by a Government Surveillance Officer to ensure that the Company and its contractors are complying with the environmental terms and conditions applied to the Quinsam Coal Project. In addition to the Government Surveillance Officer, Quinsam Coal will hire a Supervision Officer. The Supervision Officer will assist in planning and scheduling construction activities. The Supervision Officer will oversee the project development on a continuous basis, help to control environmental impacts in the field, and ensure that the project is built according to environmental specifications. Another component of the program is the Environmental Procedures Manual, which will be discussed by Dr. Robert Hawes.

3) The Surveillance and Supervision Program will be in addition to the on-going construction and operational environmental monitoring and reclamation programs.

4) The Company is committed to hiring a senior Supervision Officer who will have the capability to undertake the task. The key responsibilities of this person will be to ensure that environmental controls included in the project specifications are properly implemented. The responsibilities include maintaining close liaison with the Government Surveillance Officer and public groups, promoting environmental education in the Company through training programs and carrying out monitoring activites.

   The Supervision Officer will be a senior person in the Company and will report directly to the Property Manager. The Supervision Officer will have both the responsibility and authority to enforce environmental specifications and controls on the property.

Dr. R. A. Hawes, Ph.D., of Norecol Environmental Consultants Ltd., gave the Commission the following testimony:

1) He said he had an Honours B.Sc., degree (Botany) from the University of Victoria in 1969; a Master's degree in Soil Science from the University of British Columbia in 1974; and a Ph.D. in Environmental Management and Planning from Cornell University in 1978.

2) He also said that he had professional experience in environmental management, and had worked in research and development at B.C. Research, in Government and with Industry.

3) He said that he was first engaged by Quinsam Coal in March of 1982 when Norecol Environmental Consultants Ltd. was asked by Quinsam Coal to assist in completing the Stage II Addendum report. In May of 1983, Norecol was requested to help develop an Environmental Supervision, Surveillance and Monitoring Program. This included developing the format and table of contents for the Procedures Manual, which will be completed prior to project construction. Development of the Supervision and Surveillance Program with the Procedures Manual, which is an integral part of the program, has been undertaken through discussions with the Provincial Government to reach a mutually satisfactory program.

4) A Procedures Manual is a document that is specific in describing planned protection procedures, methods of responding to environmental problems and outlining contingency plans for scheduling design, construction and operation of the project.

5) The Quinsam Coal Procedures Manual will:

   - clearly state the Company's and Government's environmental policies for this project;

   - provide both general as well as specific construction guidance, for example, on construction and maintenance of ditches and stream crossings;

   - be based on current, sound engineering construction practices as developed in the mining and construction industries;

- serve as a useful working reference document for mine personnel;
- be acceptable to Government agencies, and be organized in a manner directed specifically at construction processes;
- be flexible to the extent that it can be adjusted or updated in response to alterations or additions to the mine construction and operation plans,and can incorporate final environmental design specifics as they are produced; and
- serve as a source from which contract documents can be prepared that assure achievement of environmental protection goals.

6) The subject matter for the proposed Table of Contents for the Procedures Manual, is as follows:

- a statement of both Quinsam Coal's and the different levels of Government's environmental policies for the project;
- a composite list of Quinsam Coal's environmental commitments made in the form of environmental reports submitted to regulatory agencies and made at public meetings and hearings;
- a description of the main duties and responsibilities of Quinsam Coal's environmental supervisor;

  This would include the proposed communication-relationship between this person, the Property Manager, on-site project engineers, contractors and the Government's environmental surveillance personnel.

- a general outline of the procedures used by the environmental supervisor for conducting an environmental inspection.

- step-by-step procedures for incorporating environmental protection measures into the project facilities design and planning, and for assuring that environmental protection measures are fully and accurately incorporated into the construction contract documents;
- a description of the content of any environmental education or training programs or environmental briefing sessions to include who they should be directed at, and what the subject matter should be;
- a listing of all applicable environmental legislation and permits required for each construction and operation process. The listing will include local government contact persons.
- A series of index maps will be prepared to show environmentally-sensitive areas, the nature of the sensitivity,and prescribe recommended protection measures.

Bonding

Mr.J. O'Rourke, President of Quinsam Coal Limited, gave the Commission the following testimony:

1) Quinsam Coal Limited has submitted an application for a reclamation permit in accordance with Section 7 of the Mines Act. The Company recognizes that it will be necessary to deposit a bond with the Minister of Finance in an amount the Minister determines, but not exceeding $2,500.00 per hectare of land in use and unreclaimed at any one time. Because the Quinsam Project will be developed with a method that utilizes a continuous mining and reclamation program, the amount of unreclaimed land will be minimal at any one time. As a B.C. mining company, it is Quinsam's experience that the reclamation inspectors visit the properties frequently to ensure that the companies are in fact complying with the reclamation requirements.

The Company expects that the amount of disturbed land at any one time during the course of mining operations will not exceed 100 hectares. On this basis, the Company is prepared to put up a reclamation bond of $250,000 at the start of operations, and have the bond adjusted upwards or downwards from time to time as the situation demands.

2) Quinsam Coal Limited has been identified as being a development in a sensitive area and, therefore, the Minister of Environment has required special bonding under the Waste Management Act. The Company reviewed similar requirements for B.C. mines, and believe a Performance Bond would be appropriate for this project in accordance with Government policy, but believe it should be in the order of $1,000,000. The Company cannot conceive of any incident or accident which would require funds in excess of this figure. Mr. O'Rourke said that he knew of only one other mine in the Province that is required to put up this type of bond, and that is Island Copper, at the north end of Vancouver Island. Their bond is $1,500,000.

Environmental aspects of the Quinsam project have been well documented and thoroughly examined by the Company and our insurers. The risk of an accident or spill is very minimal, and we will discuss the implications as they would apply to the Company's insurance. The Company has $10,000,000 insurance which would be available for accidents or upsets from mine operations. It should be noted, however, that any person or organization making a claim against the Company, in which the insurance money would be involved, would have to prove the claim in a Court of Law.

RECLAMATION:

Mr. David Polster, M.Sc., of Norecol Environmental Consultants Ltd., gave the Commission the following testimony:

1) He said that he had an Honours BSc. in Biology and a Masters degree in Plant Ecology. He said he had worked in reclamation research and planning for the last six years.

2) He then told the Commission of eleven projects in reclamation research or planning, for which he had been responsible. He also said that he had been involved in the preparation of a number of technical reports on the subject of reclamation.

3) He told the Commission that he and his organization had been hired to prepare reclamation plans for the Quinsam Coal Ltd. project, and to initiate a program of reclamation research to demonstrate the feasibility of reclaiming the area after mining.

4) He said that reclamation planning involves a synthesis and analysis of a wide variety of information, including engineering plans and the environmental baseline information. The reclamation plans for the mine have been developed in conjunction with the engineering and mine design plans. Reclamation ideas were incorporated in the engineering plans and vice-versa. This integration is the key to successful reclamation planning. By developing the reclamation and mining plans together, a system of extracting the coal in a manner which respects the surrounding environment has been achieved.

5) Forestry, recreation, wildlife habitat and aquatic habitat are currently the dominant land uses in the area. The reclamation plans have been developed to maintain these uses over the long term.

6) Four major objectives have been formulated for the reclamation program. These are:

    1) The return of the land surface to a shape which is compatible with the projected future uses in the area, and which is similar to the surrounding terrain.

2) The control of surface erosion by conducting revegetation on a continuing basis as the sites are mined.

3) The restoration of productivity on the sites disturbed by mining, and

4) The development of self-sustaining ecosystems on the disturbed lands.

7) Mr. Polster then went into a detailed description as to how the various pits would be reclaimed, including rock slope angles, etc. In this description, he told the Commission how the system of roads, drainage channels, settling ponds and mine-site areas will be returned to a natural setting. He described the reconstruction of suitable soils in the pit areas and the program of revegetation.

8) He said that revegetation has been designed to accomplish two primary aims; the control of erosion and the return of productive potential.

9) The reclaimed sites will be periodically inspected to ensure everything is going well. Maintenance may be required in some cases in the form of repeat seeding, fertilizing and planting. The design has been developed to minimize the need for repeated fertilizer applications. However, we expect that there will be situations which will require remedial work of one sort or another. The maintenance program has been designed to accommodate this.

10) He pointed out that one of the key features of the mining and reclamation programs is the sequential nature of development and reclamation. There will not be more than about 100 hectares which are disturbed and not reclaimed at any one time.

11) The reclamation research program was initiated in April 1982 to complement the reclamation planning study. The major aim of the research which has been conducted so far has been to demonstrate the feasibility of different treatments for reclaiming disturbances that will be created through the development of the Quinsam Coal Project. In addition, it was decided that it would be useful if the research could also serve to reclaim some of the sites which were already disturbed.

Three major aspects were tested. The first, the ability to rapidly revegetate and stabilize disturbed sites, was tested on a steeply sloping road adjacent to the Quinsam River. The second aspect of the reclamation program was to test the effects of various substrate development scenarios on the growth and development of the revegetation species. An old test pit area within the boundaries of the proposed 4S pit was selected as the site for these trials. The third aspect of the reclamation research program was to test the growth of trees on the various substrates and in various cultured situations. These tests were conducted in the 4S pit area as well as on the sloping road.

12) The results of the reclamation research which has been conducted thus far have proved a number of points:

1) Reclamation at the Quinsam Coal mine-site, as presently planned, will be effective at reducing surface erosion.

2) Reclamation at the Quinsam Coal site will be far easier than at many other existing coal mines in British Columbia, due to the favourable climate and the methods to be used for mining.

3) Early results from the reclamation trials indicate that sites disturbed by mining can be brought back into productive forest production, and,

4) I believe the reclamation program as currently designed will result in a pleasing area in which a variety of recreational pursuits will be possible.

THE INTERVENORS' PRESENTATIONS

[illegible]

SUMMARY OF THE INTERVENORS' PRESENTATIONS

The Commission heard 36 submissions during the 20 days of public hearings. Many of the days included evening sessions. Of the 36 groups or individuals who came before the Commission, 29 were totally or partially against the proposed project, and 5 were for the project provided that appropriate mitigating measures could be included in the project to minimize or eliminate any detrimental effects to the environment.

A great number of those that were totally against the project earned their livelihood from tourism and/or the fisheries, primarily in the Campbell River area. Some of the general comments in the briefs of those who were against, or partially against, the project, were as follows:

"For the fears that we have and the statements we have made, River Sportsman Ltd. is willing to sacrifice the short-term gain and officially goes on record as being totally against the Quinsam Coal development". (River Sportsman Ltd.)

"My contention is that no matter how sincere the intentions of the applicant are, there is no possible way that a massive surface disruption by enormous machinery such as is planned can happen without introduction into the watershed of silt and whatever chemicals are present in the mined materials. It is defying reality to suggest any form of containment; it simply rains too much. Chemical neutralization as proposed introduces many unknowns". (Ruth J. Masters).

"Natural disasters do occur. What might happen to the planned settlement ponds, etc. if we should experience an earthquake as we did in 1946?" (Joan Pengelley).

"Finally, Mr. Chairman, any reasonable person who has looked at the area, the size of the watershed, the low summer flows, the increased water temperature, the low buffering capacity of the stream, the high rainfall, the high sulfur content of the coal, must come to the conclusion that if Quinsam Coal is allowed to proceed, we face a disaster". (United Fishermen & Allied Workers Union).

> "As long-time residents of this area and relying primarily on sports fishing as the basis for our Company's livelihood, we , April Point Ltd. are gravely concerned over the short and long-term effects of the proposed strip mining for coal on the Quinsam watershed ..." (April Point Fly Fishing Club).

> "Since this mine appears fated to be a reality,Mr. Commissioner, you must, we submit, build that phrase "what if" into each and every one of your recommendations in order that if this mine is to be a reality, this will be the most rigidly controlled surface mine ever. Campbell River as a community is already paying a heavy price for the failure of pollution controls in the past. It should not, we submit, be subjected to risk a second time, and we enlist your assistance in this regard". (Haig-Brown Kingfisher Creek Society).

> "Mining cannot be the basis for stable economic growth in this region. Apart from the threat it poses to our more valuable recreation and fisheries resources, mining can only be of temporary economic value to this region". (Mayor of Campbell River).

> "City Council has determined that the most important issue facing us is the preservation and protection of our water quality. We are prepared to accept development in our watershed only so long as and to the extent that this can be done with no deterioration of our water quality as it affects people, fish and wildlife". (Mayor of Campbell River).

> "There must be local input into control of water resources at every aspect and level of decision-making. We are not content to rely on promises of industry or the protection, however well-intentioned, of government agencies". (Mayor of Campbell River).

> "We would therefore urge that until and unless there is an iron-clad guarantee that the habitat for fish will not be adversely affected, the Quinsam Coal project be disallowed". (Campbell River, Courtenay & District Labour Council).

Still others were more optimistic that environmentally-acceptable controls were available, and that environmental protection could be achieved.

> "The Associated Chambers of Commerce of Vancouver Island wish to place on the public record its endorsation of support for Quinsam Coal Limited's position that their proposal to mine coal by surface means in the middle Quinsam watershed can and will be accomplished in an environmentally acceptable and beneficial manner". (Associated Chambers of Commerce).

"I worked for Utah Mines in Port Hardy for three years. Environmental awareness was stressed from the first day of employment. It was interesting to see how little a well-run mine had impacted the environment". (Kevin Rundle).

"It is our belief that the coal project with the appropriate input at all levels of government, organizations, and private citizens, can and will, if allowed to proceed, provide Campbell River with the unique opportunity of demonstrating to future industrial applicants, not only our desire to broaden our tax base and provide meaningful employment to a significant number of residents, but of our commitment to protect existing industries, namely the fisheries and tourism". (FACTS)

"We cannot demand a nil effect. This is not the time to join hands and march together into the past. What we must demand is that a real balance be both looked for and found. We can and must insist that Quinsam Coal Ltd. be prepared to commit itself to ensuring that the Quinsam Coal Project is environmentally sound, and that the Company is prepared to dedicate time and effort and money to that end". (International Union of Operating Engineers).

One of the themes that ran steadily through the testimony related to the detrimental effects of other mining projects:

"Further, we know that Buttle Lake is being degraded by heavy metal contamination due to Westmin Resources and that the interaction of two sources can have a multiplier effect". (SPEC)

Some of the intervenors spoke of their memories of the past, and of their fears of the future:

"As a boy, my first memory of the Trent River at Royston was a river running rust colour and devoid of fish life. This condition as I remember would be from approximately 1920-1950, and was undoubtedly caused by the acidic content of water which found its way from the coal mines". (Duncan Marshall).

"I was raised on a farm in the Cumberland area and personally witnessed the damage done to creeks as a result of coal mining". (Horace Calnan).

Some of the intervenors were critical of the Commission's Terms of Reference and the timing of the hearing relative to approvals:

"...the Green Party would urge this Inquiry to dissolve itself because it cannot provide "a full public review" within the confines of the very restrictive terms of reference". (The Green Party).

"A hearing such as this would be more productive had it come before the Stage II approval-in-principle had been granted. Then all aspects and particularly the socio-economic studies could be addressed. The omission of the socio-economic studies has left many of our supporters frustrated as they are genuinely concerned that their way of earning a livelihood is threatened by this coal development". (VIRS).

"We wish to express our extreme disappointment that the terms of reference for this Inquiry are exclusive of economic or social impacts of the proposed development. To our mind, it is ludicrous to consider the environmental impacts of this project in isolation". (B.C. Wildlife Federation).

Spokesman or witnesses for each of the intervenors gave the Commission the following information:

1) April Point Fly Fishing Club

Mr. Warren Peterson's testimony was as follows:

(a) Water quality in the area has experienced deterioration in the past primarily because of logging operations which did not pay proper attention to the environment and the needs of the fishery. Only recently has there been some improvement, and he now wondered whether the community can really afford to take another chance with this mine in the Quinsam watershed.

(b) With the coming of the mine, he was concerned about the loss of aesthetic and visual beauty in the area.

(c) He said that the maintenance of the air quality in the area to be mined would be questionable.

(d) Air and water quality protection at the dump sites and transportation areas seems impossible.

(e) He was concerned that there would be a build-up of contaminants with synergistic effects on streams and fish stocks. He said that the anadromous fish stocks are a valuable resource, which is already threatened in many ways. This resource provides recreation and jobs, and he felt that the community could not afford to gamble away this resource for a new mine.

2. Associated Chambers of Commerce of Vancouver Island

Mr. Colin Smith's testimony was as follows:

(a) He said that he was a graduate of U.B.C. in Applied Science, with post-graduate degrees in business and mineral engineering. He said that he had some 10 years experience in the mining industry in both Canada and the U.S.A., but currently was the owner/operator of the Dolphins Resort.

(b) He said that he is a member and past chairman of the Minister of Fisheries Sports Fishing Advisory Board, which advises the Minister and Dept. of Fisheries and Oceans on sports fishing matters in the Pacific Region.

(c) He said that as a result of his education and experience in the mining industry in general, and of this project in particular, and with his intensive involvement in sports fishing related matters, he now offers the views of the A.C.C.V.I. on this project, with some personal knowledge of both of these aspects.

(d) The A.C.C.V.I. represents some 16 Chambers of Commerce throughout the Vancouver Island region and Powell River. The Campbell River Chamber of Commerce is not a member.

(e) The A.C.C.V.I. supports the proposed mine and believes that Quinsam Coal Ltd. can bring the mine into production in an environmentally acceptable and economically beneficial way.

(f) The A.C.C.V.I. believes that it is of the utmost importance to safeguard the environment in every way. Development should only be considered and undertaken on supportable data and should take into account the technical and economic feasibility together with the assimilative capacity of the environment on a site specific basis.

(g) The A.C.C.V.I. recognizes that the salmonid stocks of the Quinsam/Campbell water systems represent a particularly valuable long-term renewable resource.

(h) The A.C.C.V.I. does not subscribe to the view that the extraction of the non-renewable Quinsam coal resource will result in the destruction of the fisheries resource, because:

- The primary contribution of natural water into the lower Quinsam is the Iron River, whose watershed will not be impacted by the proposed mine development.
- While the lower Quinsam is an important water source to the Quinsam Hatchery, the primary source of water to this facility is Cold Creek.
- Even in the event of an unanticipated and unmitigated negative impact on the Quinsam River, the impact on both the Hatchery and the fish runs to the Iron/Quinsam would be less than catastrophic.
- A significant number of chinook and coho salmon taken each year by sports and commercial fishermen alike in the Campbell River area, are migrating through the waters of Discovery Passage to other river systems and, hence, are available for harvesting over and above Quinsam/Campbell bound salmon species.

(i) The A.C.C.V.I. believes acid mine drainage should not be a problem, as there is an abundance of acid consuming material in the host rock in the area for neutralization of the acid-bearing components. There is a marked difference between the rock types in the Quinsam and Buttle Lake areas. The host rock in the Buttle Lake area is acidic volcanic and has sulphide minerals, which has resulted in the generation of acids and heavy metal pollution in the Campbell system.

(j) The A.C.C.V.I. supports the proposed suspended solids level of discharged material to the Quinsam system, which is stated to not exceed 25 mg/l. Mr. Smith said that he knows this level can be met as he has witnessed the attainment of similar final standards at Widco and a mine in Japan.

(k) The A.C.C.V.I. freely subscribes to a thorough on-going monitoring program for air-borne dust particles and all surface and groundwater flows. The A.C.C.V.I. also suggests a review committee of seven persons representing the Company, the Municipality, the Regional District, two Provincial Agencies and two Federal Agencies.

(l) The A.C.C.V.I. is confident that reclamation of the mined-out lands can be readily accomplished. The A.C.C.V.I. makes this statement based on its observations of the Company's experiments at the site and the results obtained at the Widco Mine.

(m) The A.C.C.V.I. suggests that the type of financial guarantee required under the provisions of the Waste Management Act should be of an insurance-like nature rather than additional bond acquisitions. The Company would be able to acquire such coverage at a fraction of the cost of out-of-pocket bond purchase.

(n) The A.C.C.V.I. recognises the right of all people to continue to enjoy the environment to which they have become accustomed, the natural environment as well as the technological, economic, social and material environments which are equally important to the well-being of our people.

3) The B.C. Wildlife Federation

Mr. W. R. Harling's testimony was as follows:

(a) The B.C. Wildlife Federation represents between 20,000 and 25,000 people from some 150 Fish and Game organizations in several geographic regions of the Province.

(b) The B.C.W.F. registered its objection to the shortage of time between being accepted as an Intervenor and the date of the hearing, as this time limitation made it difficult to prepare an adequate brief. The B.C.W.F. also raised objections to the limited "Terms of Reference" for the Inquiry.

(c) The B.C.W.F. believes that no matter how well intentioned the Company may be, and how highly learned its expects may be, they are not infallible. Mistakes have been made in the past, and society would be extremely naive to believe that mistakes will not happen again in the future. On this basis, the B.C.W.F.'s specific concerns were stated as follows:

- The settling ponds only have a capacity for a 1 in 10 year flood. What happens during flood periods above that level?

- The B.C.W.F. does not want the 25 mg/liter level to be an average. It believes it should be a maximum upper limit.

- The B.C.W.F. is concerned that Calgon M503, the preferred flocculating agent, may not be non-toxic to fish and the invertebrate fauna upon which fish feed. It is concerned that the flocculating agent may be changed to an agent which may be more efficient but more toxic to fish. It is also concerned that the sediments from the mine could smother fish eggs in their gravel spawning beds.

- The B.C.W.F. believes the performance bonds, as they are currently applied, are, from cursory examination, totally inadequate.

- The B.C.W.F. believes that to ensure compliance with agreed constraints during the mine operating life, continuous on-site inspections by a qualified independent individual is required. The B.C.W.F. suggests that a surveillance committee, to review the inspector's findings, should be formed, consisting of one member from the Ministry of Environment, one from Fisheries and Oceans Canada, one from the District of Campbell River, and a public representative chosen by the environmental groups intervening at this inquiry.

(d) The B.C.W.F. insists on a written commitment from the Government that the mine will be shut down if the Company violates the conditions of its permit until the problems are rectified. It also believes penalties for infractions should be progressive.

4) Mr. Barry Baldwin

The main points of Mr. Baldwin's testimony were as follows:

(a) The Company's proposed monitoring program is completely inadequate. Also, the measures the Company claims it will take in the event of a disaster are vague.

(b) His main concern is with the steelhead trout, indisputably the premier freshwater game fish available to the British Columbia angler. Over the past dozen years, the quality of steelhead fishing available to Vancouver Island fishermen has steadily declined. This decline has been caused primarily by two factors; overfishing and habitat destruction.

While the rainbow (steelhead) trout is a hardy creature capable of tolerating some fairly intolerable conditions, there are limits. Once the water quality deteriorates to the point where the Quinsam hatchery can no longer raise steelhead, then an important part of the plan to increase steelhead population is lost.

(c) Since the 1974-75 steelhead fishing season, over fifty thousand angler days have been spent on the Quinsam River to produce a total catch of over 14,000 fish; these figures from a small river with probably less than ten miles of water accessible to the steelhead fisherman give some indication of the importance of the fish and hence the water quality to the fishing public.

5) District of Campbell River

The main points of Mayor Ostler's testimony were as follows:

(a) We must speak for the Campbell River of the future as well as the present, and ask whether the long-term cost of this proposal will exceed its short-term benefits.

(b) In the 1960's, despite local concerns, mining began at the head of Buttle Lake following guarantees and assurances that pollution control methods were fail-safe, and that no harm could come to the water system. This was not the case. The lakes and rivers have suffered harm from which they may never recover. The great salmon run has faltered.

(c) If the Quinsam Coal Project goes forward, we must determine and be assured that the price is not too high.

(d) We are anxious that this community grow in an orderly and planned manner, and it is not lightly that we would discourage a job creating industry from locating here.

We must, however, assure ourselves that the anticipated changes contribute not only to our present economic growth, but to our quality of life.

(e) We do not undervalue the importance of our local resources. But it must be emphasized that the economic health of Campbell River will be assured by long-term exploitation of renewable resources, especially our forests and commercial fisheries. Income from mines whose worth is temporary must rank low as a priority.

(f) While we have a very real concern for the long-term economic health of this community, we harbour serious reservations about the harmful side effects of industrial growth, especially as it pertains to water quality and environmental impact. The residents of this community will bear the consequences of any error made by the Company or the Government regulations. Despite this, we have no formal voice in their decisions.

(g) On the basis of the foregoing information, the Council believes that there are several measures which are required, which are as follows:

- There must be local input into control of water resources at every aspect and level of decision-making. We are not content to rely on the promises of industry or the protection, however well-intended, of government agencies.

- A comprehensive data base reflecting the present status of water quality must be developed. Only through a clear and substantial knowledge of the present situation throughout our watershed can future changes be known and controlled.

- There must be put in place a system of surveillance and monitoring so that changes in water quality are discovered and reversed before damage is substantial or permanent.

- Before mining is commenced in our watersheds, we must be assured that there will be no negative environmental impact during or after completion of the mining.

- Safeguards must be provided to assure that the community has legal and economic recourse to require adherence to environmental protection guidelines, and to be indemnified against any harm caused.

District of Campbell River (Continued)

Mr. G. R. Peterson's testimony was as follows:

(a) He told the Commission that he received a Masters Degree in Zoology from U.B.C. in 1966. Further, he said that he had worked for the Province (Fish & Wildlife Branch) for 9 years and for Howard Paish & Associates Ltd. for the last 11 years as a principal and senior biologist.

(b) Positions he has held included President of the B.C. Chapter, Canadian Society of Environmental Biologists, President of Pacific Fishery Biologists, and President of North Pacific International Chapter of American Fisheries Society.

(c) As a consulting project manager or senior biologist, he said that as part of his past work, he had carried out some fourteen major studies of an environmental nature for government, industry and Native Indian Councils.

(d) Of particular relevance to this inquiry, he said he had been retained by the District of Campbell River to advise on the general issue of water quality of the Campbell River area, with specific reference to (1) present water quality suitability for fish production, domestic use, and recreation, (2) future water quality condition as could be affected by potential development and (3) strategies for maintaining suitable water quality for future use.

(e) A comprehensive description of the ambient water quality, flow characteristics and the ecosystem of the Quinsam River system, together with the values of aquatic resources and uses,is a requisite to a full understanding of potential impacts and to the planning which would avoid or successfully mitigate impacts.

(f) The District of Campbell River needs an adequate guarantee of effective avoidance or mitigation of potential impacts from acid drainage, nutrients, sedimentation, and other water quality changes. He said that he felt that preventative measures offer a greater guarantee of protection than treatment, and submitted that Government directives and subsequent permits, licences and approvals should reflect this priority.

District of Campbell River

(g) Guaranteed environmental protection requires adequate monitoring to determine the effectiveness of these preventative and mitigation measures, through programs of enforcement and impact assessment.

Physical and chemical water quality standards for effluents and receiving waters should be the primary basis of enforcement and protection, not the demonstration of biological loss. Future monitoring programs for enforcement should therefore include only water quality parameters. Biological measurements are useful to show how adequate the water quality standards and the enforcement measures have been in protecting aquatic resources, but cannot be used as primary enforcement monitoring parameters. The biological condition, as perhaps a delayed reflection of water quality change, cannot be relied upon for the kind of immediate response needed to initiate mitigation or other corrective measures.

With respect to water quality monitoring, it is important to differentiate between monitoring controlled effluents to meet the strict terms of Waste Management permits, and monitoring receiving waters at river, streams and lake stations for purposes of estimating effects of the effluent on aquatic life and other uses. Adequate protection of resources will not be met by monitoring effluents only, and in this respect, the general objectives of the Monitoring Sub-Committee of the Coal Guidelines Steering Committee are sound.

Criteria for settling pond effluents should include all those identified materials expected to result from the mine operations.

Criteria for receiving waters should include effluent parameters plus limnological parameters that will allow calculations or judgements to be made of the biological effect of the effluent. Parameters reflecting drinking water suitability must also be included, particularly for Quinsam River stations. The specific sampling techniques and frequencies for this monitoring as suggested in "Guidelines for Canadian Drinking Water Quality", published by Health and Welfare Canada should be adopted.

(h) To be meaningful to resource protection, the monitoring program requires that water quality requirements or standards be identified.

It is understood that the Provincial Government has, through its Ministry of Environment Strategic Planning Program, the intention of establishing such water quality standards for the general Campbell River area. He urged the Ministry of Environment to complete this task and to incorporate into these standards the requirements by the Federal Department of Fisheries and Oceans for salmon as well as those requirements that could be expressed by the District of Campbell River in support of fish production as well as for recreational, aesthetic and drinking water uses.

As the salmon and trout hatchery is located downstream and is a user of Quinsam River water, one appropriate basis for setting receiving water standards might be Department of Fisheries and Oceans "Summary of Water Quality for Salmonid Hatcheries", at least for the Quinsam River at Monitoring Station "G", downstream of the mine operations.

As well, the standards suggested by Health and Welfare Canada in "Guidelines for Canadian Drinking Water Quality" should be adopted.

(i) Appropriate contingency plans and installations to mitigate impacts must be in place should preventative measures fail.

Since there is some inevitable risk of failure associated with any preventative and mitigative measure, a fall-back plan and/or installation will be necessary particularly for greater than expected releases of acid waters, nutrients, sediments, or heavy metals as determined by monitoring of either the effluent or receiving waters.

(j) Adequate bonding must be prescribed for rehabilitative measures should controls fail. The District of Campbell River has an obvious concern for the very long term that quite likely exceeds the terms of most Government permits and licences, as well as the planning horizons of most Government resource agencies. Accordingly, it is appropriate that the District of Campbell River participates first of all in the setting of the terms and size of bonds, and, secondly, in a periodic review of the progress of the rehabilitation measures to determine the continuing need for the bond after mining access.

(k) Surveillance and supervision is needed during all phases of construction, operation, and reclamation to ensure that planned impact preventation and mitigation measures are actually carried out.

Environmental inspectors and officers must have clearly defined roles and authorities for environmental protection, with reporting procedures above the daily operational management level within the Company, and directly to the Ministry of Environment and District of Campbell River as well.

Surveillance and supervision procedures must be detailed for a variety of conditions and contingencies, most importantly for periods of emergency, such as extreme rainfall or floods. These procedures must demonstrate that the Company's committed high priority for environmental protection will have some meaning in times of crisis, when it is recognized that Company staff may be faced with conflicting priorities - production and protection of the mine and facilities, and protection of water quality.

(l) The planning of the present mining operation must accommodate the water quality control needs for potential expansion. The concern is that expansion may stress or overload the presently planned measures and installations for impact control.

Accordingly, it is imperative that the Company and Governments together examine the total assimilative capacity of the Quinsam River system to handle waste products from coal mining and processing operations,and determine,first of all,whether future expansion can be handled in a manner similar to that of the present plan, or whether other techniques will be required; and, secondly, whether the present plan in any way precludes or limits opportunities for future abatement, and thereby compromises long-term assurances of environmental protection.

(m) Several areas of the Company's reclamation submission appear quite satisfactory; notably the commitment to a policy of "control-at-source" for potential water contamination. The outline of reclamation plans appears sound and the Company's commitment to adopt the plan by the consultant is a favourable sign. The Company's commitment to continue monitoring until the system has become stable and self-sustaining in accord with assessment by both Company and independent determination is a further favourable indication that environmental needs can be properly addressed.

However, some items are still of concern. These items are as follows:

- Insufficient attention has been given to the storage of tills and topsoils.
- There is some uncertainty about the possible release of phosphorus from fertilizers.
- There is a need for long-term surveillance of the reclaimed site to ensure that no decanting of contaminated groundwater takes place.
- Work still needs to be done to better understand and predict the long-term physical and chemical nature and stability of the reclaimed sites.

(n) The surface water management plan appears to be basically sound, with a few reservations. These reservations are as follows:

- There is uncertainty for the integrity of the surface water drainage system and ponds from damage resulting from a major flood event.
- There has been no adequate measurement to date of suspended sediments in the area of the minesite during significant rain events.
- What control will be provided for water-borne materials other than suspended solids?

(o) It would appear that there has been significant neglect of the question of the chemical nature of the nitrogen escapement to the surface waters. Since nitrites and free ammonia are possible forms which have been found in other coal mine areas, and are toxic to fish, it is submitted that more work must be undertaken to determine if such materials will be produced at Quinsam, if they are likely to enter surface waters, in what concentrations, and what effects they may have on the aquatic ecosystem.

(p) There appears to be still some outstanding disagreement as to whether nitrogen or phosphorus is limiting in the Quinsam system. This issue is fundamental to the whole nutrient question, and its resolution must be sought before any plans are finalized or approved.

(q) With regard to the use of mini-cleaner model, I suggest that in order to increase the confidence in the modelled prediction of effects, the modelled baseline condition be tested against measured parameters of the Quinsam system. Further, if this model is to be improved and used in other B.C. locations, its predictions should be tested against the total monitored Quinsam experience. Also, it is suggested that the model be subjected to variable inputs to provide for the contingencies of control system failure, or for the addition of nutrients from sources other than the mine site.

It would appear that the threshold level of phosphorus which must be added to the system before problems are encountered has not been sufficiently refined. In this regard, contingency plans should be adopted to intercept any movement of phosphorus into surface waters, such as from the sewage field or fertilizer application, and measurements should be made of possible sources, such as atmospheric and other watershed activities, present and future.

(r) The Company has carried out only incidental measurement of drinking water parameters. As the evaluation of drinking water requires specific sampling techniques and frequencies for various parameters, it is submitted that such sampling be undertaken by the Company according to the "Guidelines for Canadian Drinking Water Quality", suggested by Health and Welfare Canada as part of the background understanding, and included in the future monitoring program. I am encouraged by the Company's commitment to consider this matter.

District of Campbell River (Continued)

(s) The mine plan as proposed, together with the evidence presented on groundwater and geological conditions, seem to offer reasonable opportunities for avoiding acid generation or controlling acid mine drainage.

In particular, the following conditions and planned measures seem effective controls:

- an abundance of acid-consuming rock for backfilling;
- planned simultaneous mining and reclamation/ burial to minimize exposure;
- planned deep burial of acid-generating material under acid-consuming rock;
- containment of any resulting acid waters within the pits;
- contingency neutralizing facilities in the pits should acid generation occur.

Several areas of uncertainty remain, however, that must be resolved in order to provide the assurance that controls will be effective. These include plans for burial and full reclamation of unfinished pits should the Company abandon the project at any point, and specific monitoring and supervision programs for the reclamation, housekeeping, and surface water management programs. In this latter regard, I am encouraged by the Company's commitment to:

- adopt the more conservative monitoring recommendations suggested in the Sturm Environmental Services report, and
- continue the monitoring for acid mine drainage until full restoration of the groundwater table has been reached.

(t) The development of construction and operational monitoring, surveillance and supervision is critical to the preservation of the District's interests. Specifically, several measures are necessary to achieve this end.

District of Campbell River - Conclusion

- The assurance that any permits, licences and approvals which are issued are conditional upon receipt of necessary outstanding data and development of satisfactory final mine plans. Final plans must stipulate measures to ensure control at source and treatment or contingency plans in the event of control failure.

- The involvement of the District of Campbell River or its technical representative in all construction, operational and reclamation monitoring. This involvement must be participatory and not as a passive recipient of information after the fact.

- A monitoring program which is more than mere passive recording of breach or detrimental effects. A system of stringent measures to halt any adverse impacts is critical to the effectiveness of any program of this nature. The decision on the appropriate course of action to be taken in the event of adverse impacts must be made in conjunction with regulatory agencies, and the District views as indispensable that it be involved in this process as well.

- Bonding that is adequate to cover all costs of reclamation and rectification in the event of system failure during construction, operation and reclamation phase of the mine development. Again, participation by the District of Campbell River in bonding decisions is warranted.

6) Campbell River Estuary and Watershed Society

Mr. Don McIvor gave the following information to the Commission:

(a) The Campbell River Estuary and Watershed Society was formed over five years ago for the purpose of protecting and restoring the fish habitat of the Campbell River system.

(b) Consider the following: this fall, 60,000 salmon are returning to spawn in the Quinsam River; next spring, 13,000,000 fry will be born in its waters, and over 1,000,000 young salmon will make the Quinsam River their home for a year or more; a multi-million dollar hatchery is in production on the Quinsam River; hundreds of jobs in commercial fishing and tourism depend on fish from the Quinsam River. Sports fishing by thousands of people depends on fish from the Quinsam River, and well-managed fish are an annual crop in perpetuity.

(c) The proposal by Quinsam Coal Company to strip mine coal has the potential to destroy fish habitat in the Quinsam River and neighbouring lakes. Based on studies by engineers and scientists, the Company says it can remove coal and not damage fish habitat. Based on earlier studies and proposals, Western Mines wouldn't pollute Buttle Lake - but it did. The sewage treatment plant in Campbell River wouldn't stink - but it does. Caroline Gold Mines wouldn't spill cyanide into the Coquihalla River - but it did.

(d) It is the opinion of the members of this Society that the proposal to mine coal on the Quinsam River and along its lakes and tributaries should be denied for a number of reasons. These reasons follow:

- The Stage 2 submission and its addenda make only vague references to the system for monitoring potential hazards from the mining and processing of coal.
- We know that some industries have given their environmental staff members a freedom to work conscientiously towards environmental protection without fear of loss of job or lesser retribution for reporting failures of the Company that hires them. We know, too, that many environmental protection staffs are that in name only, and spend most of their time working at mining processes not related to environmental quality. The Quinsam Coal Company cannot expect public confidence in its proposal to hire an environmental person whose salary it pays, and who is responsible first to the Company. An environmental staff should be hired by the Department of Fisheries and Oceans, and accountable only to them and to the public.
- The control of effluents, both in non-emergency periods and in emergency situations, will be a pressing and costly factor. What contingencies has the Company offered in the event of a

serious pH problem? Expensive lime facilities would be required. We are aware that there are methods of controlling pH, suspended solids and ammonia, but we are also aware that there is no economical way known to control nitrates. With costs so excessively high, how will the Company control the nitrates they dump in the lakes. Eutrophication of the lakes in which they propose to dump nitrates is inevitable.

- The upper ends of Long Lake and Middle Quinsam Lake, where the Company has proposed to dump the nitrates, are particularly important areas for young coho. Long Lake is known to be one of the most productive areas for rearing young coho, and another productive area, Flume Lake, would require the coho to pass through the effluent dump on Middle Quinsam Lake if they are to reach it.

  The receiving environments of Long and Middle Quinsam Lakes have a low capacity for receiving effluents safely, Long Lake's flows are frequently excessively low (1 c.f.s. or less) during the year, not just in late summer. The water in both lakes is extremely soft. Soft waters lack a buffering capacity to counter any acidification from the mining operation, and in it toxic substances, such as metallic ions, are made even more toxic.

- There is concern that uncontrollable alterations in runoff will come with the removal of the forest over the expanses of land to be strip-mined. Increases in runoff will carry with it additional silting of the river. The radical disturbance to soils will adversely change the water table and the reclaimed soil will be unable to support tree growth in any way near its former productivity. Quinsam Coal Company says their reclamation methodology will be refined as mining progresses. They do not say the area will be reforested as it is now. Three square miles of forest land could be lost. The long-term effects are unpredictable, but assuredly they will be negative to the water quality of the Quinsam River.

- In the event that a decision is made to risk this great renewable resource - the fishery with its hatchery - for a relatively few jobs over an infinitesimally short time period when compared to the long range value of the fish, then the bonding to cover disasters is incredulously inadequate. Bonding by the Government of British Columbia is set at $2500.00 per hectare. Compare this with the Province of Alberta where a zoning system is in place and coal mining in high risk areas is set at $4.00 per ton. $2500 per hectare works out at pennies per ton.

  There is much at risk here: the incomes of commercial fishermen and guides; those of all workers in the tourist industry; and the great recreational advantages enjoyed by thousands of local people. Bonding must cover more than the short-term loss of the fishery or destruction of the hatchery. It must provide for people who lose their livelihood or any part of it in the likely event of the Quinsam River being destroyed.

7) Campbell River & District Fish and Wildlife Association

Norene Devlin gave the following information to the Commission:

(a) She said that she was not only a member of the B.C. Wildlife Federation, but also a member of the B.C. Trappers Association.

(b) The beaver is an important link in the ecological chain of wildlife found in the proposed coal mine area, and supports many species other than himself. Any change in the habitat surrounding the swamps and marsh areas would result in a domino effect in breaking down this delicate ecological area. For example, the total removal of vegetation in and around the beaver colony could cause the beaver to move out of the area, thus severely reducing the life support of mink, muskrats, otter, weasels, ducks and the endangered Trumpeter Swans which are known to inhabit the swamps around No Name Lake, Long Lake and Middle Quinsam Lakes as well as the lakes themselves.

(c) If Quinsam Coal is correct in their initial analysis that there will be only minor effects on existing water systems, they will have an overwhelming problem with the beavers trying to establish a new home system in the settling ponds and water runoff ditches. If Quinsam Coal is wrong, the delicate balance within the numerous ponds and tributaries could be destroyed, and the possibility of death or physical abnormalities in the pond populations including the beaver may result.

(d) The three lakes mentioned all have popular recreational use due to the plentiful numbers of trout they are known to support, and we are not satisfied that the mining processes will not have detrimental effects on these numbers due to the nitrates introduced into the beaver swamp areas.

(e) Not enough study has been done in this area, and there are too many important questions unanswered to allow the mine to proceed at this time at a production level.

8) Campbell River Residents in Support of FACTS

Jan McDade and Wayne Pernu gave the Commission the following information:

(a) FACTS (Fish and Coal Together Safely) originated because a substantial number of Island residents wished to voice their support for responsible ecologically-sound economic growth in the North Island.

(b) FACTS founding members first satisfied themselves that the ecological issues and concerns expressed in the community could be addressed by the Company. An Ad Hoc Committee was formed and our first endeavour was to gather the public support of over 1,500 Island residents. With their financial support, FACTS was able to purchase four full page advertisements in two local newspapers. FACTS made it known that support for economically-sound growth existed, contrary to statements made by local groups, purporting to represent the community and reiterated by municipal and provincial politicians. In effect, the silent majority had finally spoken.

(c) FACTS recognizes that environmental questions pertaining to the salmon industry exist, but believes these environmental questions can be answered, and that the mine project can proceed in an environmentally and ecologically sound basis and become an example to industry.

(d) FACTS has examined the Company's environmental protection plans and is satisfied that the mine will be ecologically sound.

(e) FACTS is concerned about environmental awareness. Environmental awareness is not only the responsibility of a small group of environmentalists. The need for economic development with the appropriate ecological safeguards is the responsibility of everyone.

(f) It has been estimated (from statistics taken from the Coal Association of Canada), that 4.5 additional jobs are created for every person employed directly by the coal industry. It is the responsibility of the Company to inculcate in their employees a high standard of environmental awareness, as well as safety and health regulations.

(g) A highly trained and motivated workforce, fully conversant with the ecological concerns of the local environment, would go a long way towards ensuring that any hazards are reduced to an absolute minimum. Since the bulk of the Company workforce would be comprised of local people, those responsible for the day-to-day operation of the mine would have a genuine concern for the mine's effect on the community and its environment. Additionally, an Environmental Officer should be hired, having the full authority to ensure that whenever and if ever environmental concerns come into conflict with coal production, the environment receive NUMBER ONE priority. To underline the scope of his responsibility, it is recommended that the Environmental Officer have the complete authority to halt production until all concerns are remedied.

(h) In order that employees are made very clearly aware of the commitment to protect the environment, it is advocated that a Safety/Training/Environment Manual be compiled and that it be a prerequisite of employment that all job applicants read and endorse the Manual.

(i) The Company has a moral responsibility to keep the Community informed and involved. The Company should continue the Quinsam Update publication. Periodic information sessions, where citizens can question Company officials on ecological matters that may be of current concern to them would be invaluable.

(j) The educational opportunities available in this mine project can serve as an ongoing resource for all Island students and educators interested in providing factual new technological data.

9) Campbell River & District Fishing Guides Association

Mr. Berger gave the following information to the Commission:

(a) The Campbell River & District Fishing Guides Association was established in the fall of 1968. Much deliberation ensued in an attempt to form a meaningful constitution and finally five objectives were agreed upon. It is within the spirit of two of these objectives that this testimony is given:

- To actively co-operate in the protection of our B.C. forests, soil, waters and natural habitat for game fish.
- To promote and protect the business of fish guiding and to better the interests of the members of this society.

Our current Association membership of 68 has grave concerns regarding the safety and preservation of present and future salmonia stocks in both the Campbell and Quinsam River systems.

Salmon fishing put Campbell River on the map. The least we can do is to give the survival of the salmon a fighting chance.

(b) Over the years, our clients have come to expect and enjoy certain things that for too long have been taken for granted. For example- clean water, unspoiled outdoors and fighting salmon. This will change for the worse if open-pit strip mining for coal becomes a reality.

(c) If the mine comes into existence, the environmentally sensitive Quinsam River and its watershed simply are not capable of withstanding the effects of toxins and pollutants that will inevitably be filtered into its water system due in large part to the seasonally heavy rainfall for this area.

(d) The dwindling natural salmonid stocks of the Campbell River area (especially the chinook) have been greatly enhanced by the efforts of the Quinsam hatchery. We are proud of what the mighty salmon has to offer all those who choose to reap its benefits and can only hope that through wise and judicious management, generations to come will also enjoy this truly marvellous renewable resource.

10) Campbell River, Courtenay and District Labour Council

Cameron McLean gave the Commission the following information:

(a) The Campbell River, Courtenay and District Labour Council is composed of 27 affiliated local Unions in the Community, representing 3000 union members. It is affiliated with The British Columbia Federation of Labour and the Canadian Labour Congress; as such, it can fairly be said that it is part and parcel of the mainstream of organized labour in Canada.

(b) Our primary concern in this submission is the continuation of the fish habitat in the Quinsam watershed. We have studied the Stage II documents submitted by Quinsam Coal Ltd., and we find on Page 7.1 of Volume 2 of Stage II Addendum, the Company suggests sampling of the water quality be conducted twice annually. Further, in 7.3 of the same document, they advise against any sampling of the fish or other biological organisms until there are signs of water pollution. In this day and age, these proposals are an insult to our intelligence and carry the likelihood of complete destruction of the habitat.

We submit that daily monitoring of all aspects of the water quality should be carried out. We suggest that this would not be any financial burden to the coal company as machines are now available at reasonable cost to do this automatically.

It is the fish raised in this area and downstream from it that have provided a livelihood for many fishermen as well as people connected with the tourist industry. Any adverse effect on the spawning of fish cannot help but dislocate the livelihood of workers connected with fishing as well as businesses connected with tourism, and, subsequently, the entire community. Any jobs gained from mining coal could very well be cancelled by loss of jobs in the fishing and tourist industries.

(c) We are concerned about the Quinsam Coal project because we are not convinced that it is possible to mine coal in the Quinsam watershed without damage to the fish spawn.

(d) It is our opinion that the bonding is totally inadequate. Due to the high value of the fish and the habitat in this area, any bonding should be directly related to the value of fish produced by the Quinsam system and related jobs in the tourist and fishing industries.

11) Canadian Paper Workers Union (Local 1123)

Dave Owen and Donald McLean gave the Commission the following information:

(a) The Union represents in excess of 900 workers at the Elk Falls pulp and paper mill.

(b) The Union is not opposed to economic growth in Campbell River unless the Union feels that growth could be harmful to others. It does not believe that a "clean coal" storage and barge loading facility can be built in close proximity to the pulp and paper mill. It believes that airborne coal dust and coal dust floating on the water will eventually get into the paper products produced by the Elk Falls mill, with detrimental effects to the pulp and paper company and the possible loss of jobs to the work force.

(c) The pulp and paper mill employs approximately 1500 people both hourly and staff who are directly involved in the plant processes, let alone the numerous support industry employees, loggers, merchants, B.C. Hydro, etc.

(d) Coal dust may come on-site adhering to the logs floating in the log ponds or chip barges that stretch at anchor towards Middle Point. It may even be carried to the "in plant" chip storage piles by the gale force winds that blow between Seymour Narrows and Campbell River. To the best of our knowledge, there is no known process that successfully removes carbon particles from pulp stock.

(e) The Union would like to suggest that a bond of an amount capable of paying severance or mill closure pay as described in the Union Labour Contract to every person employed at Elk Falls be established, and that this not be based on equipment equity from the mine itself but from the parent companies of Quinsam Coal.

12) Mr. Horace Calnan

Mr. Calnan gave the Commission the following information:

He said that he was opposed to the coal mine because of his past experience in the Cumberland area during the 1920's and early 1930's.

He said that he was raised on a farm in the Cumberland area and personally witnessed the damage done to the creeks as a result of coal mining. " We had a farm of about eighty acres which backed onto a gravel bank which was about a mile wide. Two of the creeks flowed through our land and these eventually joined with others to form the Millard Creek. Millard Creek runs into the sea halfway between Courtenay and Royston. These smaller creeks which fed into Millard began as springs in the gravel bank.

There was a lake on the other side of this gravel bank about a mile away called Maple Lake and the coal company pumped water into Maple Lake. This water seeped through the gravel and affected all the creeks. At first it was just one of the creeks that got bad and our cattle wouldn't drink out of it and would walk across the fields to another one. We had a well for our drinking water near this first creek that became polluted and this water, when it got bad, you could smell it in the house and taste it in all the food. We had to go and dig another well and this eventually started to smell. The water itself looked alright except for the taste and the smell of it. But we noticed that anything it came in contact with stained brown like the banks of the creek and anywhere that the water flowed on to. "

13) Discovery Guides Ltd.

Mr. Jeremy Maynard read Mr. Mike Barber's brief to the Commission. Mr. Barber had prepared the presentation on behalf of Discovery Guides Ltd. Mr. Barber is a biologist with a degree from U.B.C. He is not practicing at the present. The information be brought before the Commission was based on a review of a paper by Terry A. Haines, entitled "Acidic Precipitation and Its Consequences for Aquatic Ecosystems: A Review". This paper was published in the transactions of the American Fisheries Society, November, 1981, Vol. 110, No. 6. His synopsis reviewed the following:

i) Chemistry of Surface Waters - Changes in pH and Alkalinity

ii) Bacteria/Fungi - Effects of pH Change

iii) Primary Production - Acidification Effects on Planktonic and Benthic Algae

iv) Invertebrates - Effects of pH Change

v) Fish - Effects of pH Change

His summary was as follows:

As noted in the context of this presentation, all levels of an aquatic ecosystem are affected by pH change. My belief, from the scientific literature I have reviewed, is that salmonids in their early life stages are the most sensitive beasts in an aquatic ecosystem. This would strongly suggest that no biological parameter could ever be used as an indicator of the effect of low pH on salmon. This is because the first to be affected would be the juvenile salmon hidden in the gravel.

The low buffering capacity of the Quinsam watershed system causes it to be vulnerable to acidic input. Therefore, monitoring pH and controlling pH of the Quinsam watershed appears to be the only safeguard the salmon have against pH change. In light of industrial accidents and industrial waste harming the environment in other areas, I feel that primary, secondary and tertiary pH monitoring systems should be implemented by the mining company. As well, backup remedial systems should be in place. Study results have shown lime addition to be helpful in neutralizing acidic waters. But as stated earlier, stocked rainbow trout died in an acidified lake that had been neutralized. That mortality was associated with copper or copper/zinc uptake.

Although Mr. Barber realized that the pH of the Quinsam watershed was not scheduled to alter during "normal" mining operations, he wanted the Commission to understand the effects of an error on the Quinsam River system. His concluding statements were as follows:

- Over 10 to 15 years of coal mining of the proposed magnitude in the Quinsam watershed, the environment will discover that people and miners are human; they make mistakes. In this case, the result could very possibly be the extermination of one year's salmonid return to the Quinsam system.
- Much more has to be researched regarding pH and its effects on aquatic ecosystems as well as the effects of neutralization of surface water before mining should commence.
- One year's return of the Capilano hatchery system was destroyed by an error; introducing drinking water to the hatchery. I believe we are inviting some form of disaster, pH related or other, by allowing this mining project to go through.

14) The Green Party - Campbell River

Mr. Jeremy Maynard gave the Commission the following information.

a) The Green Party stands for long-term rationality in resource development rather than short-term "boom and bust" development.

b) The Green Party questions the wisdom of jeopardizing the renewable resources of fish and forests for this non-sustaining project. The Party represents some 27 people locally.

c) The Green Party stands for decentralized decision-making and the involvement of local communities in decisions that affect their lives and life-styles.

Mr. Maynard's testimony was of a completely negative nature, condemning the project, the Commission, the Ministry of Environment, and the Government itself.

15) Mr. M.B. Gage

Mr. Gage gave the Commission the following information:

(a) He said that he had been engaged in the logging industry in the Campbell River area since 1961, and for ten of those years, worked on road construction. He had experience with the use of ANFO as a blasting agent.

(b) His primary concern was the health and sustained yield of the local fishing resources.

(c) He said that "I feel that Quinsam Coal Ltd. cannot possibly handle its surface water problems properly and stay in business. I am referring to my extensive experience in surface water management during the construction and maintenance of logging roads. My experience has shown that even with the most careful planning during the construction phase, and diligent maintenance of all forms of drainage structures, we still get caught out by nature itself and the rainstorms which can arrive fast and frequently in this area. Quinsam Coal will be faced with even greater problems in water management than the logging companies".

(d) He said that his second concern relates to the failure rate in the use of ANFO as a blasting agent in large blasts. For example, if a 20,000 cu.yd. blast was set off with a powder factor of 1 lb. per cu.yd., which is quite common, 20,000 lbs.,or ten tons, could quite easily have a failure rate of 10%. 10% of 20,000 lbs. equals one ton, or to a fish in the Quinsam system, it is 2,000 lbs.of ammonium nitrate once a week. When ANFO fails due to moisture, it dissolves entirely. Even if all of Quinsam Coal's storm handling facilities are in good order, the chance of this build-up of ammonium nitrate in the settling ponds is inevitable and the chance of one of our local heavy rainstorms releasing the ammonium nitrate is also inevitable. Techniques have improved in the use of ANFO over the years. However, due to human error and other related factors, the figure of 10% failure is quite common and to most of us almost acceptable. Indeed, failures of up to 30% are not unheard of.

(e) He further said that ANFO was made up of ammonium nitrate and 6% fuel oil (diesel), and with a 10% failure rate in blasting, this would mean that 6000 gallons of oil would eventually find its way to the settling ponds and, hence, the lakes each year. In addition, he said that the use of 1 to 1.2 lbs of powder per cubic yard was considered to be light blasting, which would produce a high percentage of large-sized rocks. These large-sized rocks would not have a great deal of acid buffering ability.

(f) In closing, he said "I am convinced that Quinsam Coal Ltd. cannot spend the time and capital necessary to save the Quinsam watershed and its users, fish and fishermen, from a disaster of an irreparable nature. I wish to go on record as being totally opposed to any form of mining in the Quinsam River watershed by Quinsam Coal, or any other Company."

16) Haig Brown Kingfisher Creek Society

John Grant gave the Commission the following information:

(a) The membership in his Society was 89 people.

(b) The Society was incorporated in 1980 under the Societies Act of British Columbia. Its main goal was and remains the achievement of the lifelong dream of the late Roderick Haig-Brown to restore Kingfisher Creek to its natural channel within his homestead, adjoining the Campbell River. His idea, which remains our goal, was to re-create this Creek as a spawning/rearing area for fish, and as an outdoor classroom for generations to come.

(c) The Creek traditionally was a spawning channel for coho salmon and a rearing area for both coho and cutthroat trout. In an analysis, dated in November of 1975, the Ministry of Fisheries and Oceans of the Government of Canada noted that even while much bedevilled by human encroachment, this Creek continued to be sought out by coho as spawning grounds, particularly in its almost obliterated upper reaches, although in ever-decreasing numbers. In mid-August of that year, however, dry by comparison with other summers, 5,000 rearing fry were found in its upper reaches, either within or adjacent to the Haig-Brown property.

(d) The restoration of Kingfisher Creek is set to proceed to on-site work of re-establishing the stream bed, and a crossing for it under Highway 28, and the construction of the hatchery facility, all within the immediate future.

(e) This project will be rendered useless by any degradation or acidification or otherwise of the waters of either Kingfisher Creek or the Quinsam or Campbell Rivers. The impact of continued or major degradation from the Company's mine on this project will, quite simply, be total destruction.

(f) The operations of the Westmin mine have caused degradation of the community's water supply, along with major heavy metals contamination to Myra Creek, the lakes, and likely the Campbell River, despite repeated assurances from the Company and Government that contamination of the Campbell River system would not take place. The Society, therefore, is sceptical of the assurances it is now receiving on the Quinsam Coal Project, and has no confidence that the same thing which happened to the Campbell River System will not happen to the Quinsam River System.

(g) Damage to the natural environment from this mine is a certainty, the absolute minimization of that impact, and its negative effects is the only concern to be addressed. "How tightly can we control this mine's pollution" must be your point of departure, and your byword.

Since this mine appears fated to be a reality, the Commission must build that phrase "what if" into each and every one of its recommendations, in order that this will be the most rigidly controlled surface coal mine ever.

17) International Union of Operating Engineers (Local 115)

Mr. Kevin Rundle gave the Commission the following information:

(a) As a Union that represents both miners and construction workers in British Columbia, Local 115 of the Operating Engineers feel it is both our responsibility and our obligation to present our views and those of our members on the Quinsam Coal Project.

(b) Nearly three hundred fellow members of the Operating Engineers who live on Vancouver Island are currently out of work. I myself am unemployed. The unemployment rate in Campbell River is one of the highest in the Province.

(c) If Campbell River is to survive as a vital and viable community, then the community must diversify its economic base. In the last few years, the community has learned some hard lessons about what it really means to be a one or two industry town.

(d) Those lessons have not taught us that we want jobs at any cost - not at the cost of ruining the salmon fishery and destroying the tourist industry; not at the cost of despoiling our environment and the environment our children will grow up in. But we do need and want those jobs and the millions of dollars that the Quinsam Coal Project will bring to the Campbell River area.

(e) The people who work at the Quinsam Coal Project who will both live and work in the area will be among the people who will be most affected by what the mine does and will do to the environment. They can least afford not to care what the mine will do to the environment. Should the mine operations adversely affect the working environment, it will be their working environment that is affected. They will be the people whose health will be the price of the mine's operation.

(f) The question is one of balance. On one side of the balance are jobs, economic stimulation and growth; on the other side, the mine's effect on the quality of air, water and marine life of the area and its effect on the residents of the Campbell River area.

(g) When we speak of a balance we accept that there is real good on both sides of the balance. The real questions we should be asking here are: how much damage? will the project adversely affect in a serious way the quality of life of the citizens of Campbell River? And on the other side of the balance: will the damage outweigh the positive value in quality of life for the people of Campbell River? will it outweigh the effect that a successful mining project will have on the economy of Vancouver Island?

(h) We are satisfied from both what we have read about the Quinsam Coal Project and from the Company's own actions, that Quinsam Coal Ltd. is indeed prepared and committed to take care of our land, our water, our fishery and our community. The Company has already made significant changes to its plans to minimize the Project's effect on the environment and on the community. The proceedings of this Inquiry will further bind them to their promises.

18) Mr. John Keays

Mr. Keays gave the Commission the following testimony:

a) In the proceedings I was asked whether I was for or against this project. I could only answer that I was worried. I do not know if this coal can be mined in a way which protects the environment, and since the coal has never been mined here in the way that is being proposed, it is, by definition, impossible to know unless the mine goes ahead. I do know that all of the money for all of the luxuries enjoyed by those who support the project, and those was oppose it, and by the civil servants, comes from one source - Industry.

My sympathies were mainly with those who opposed the project. After examining the information provided in the opening session of these hearings, I have a great deal of sympathy for the industry.

I am going to make three assumptions, three objections to the information provided, three suggestions and one request.

b) The summptions are as follows:

- The zooplankton samples which I am in the process of examining for the Federal Government were taken in July of 1983 from the Quinsam River system with a net having a mouth opening 25 cm. in diameter, towed vertically from 10 meters depth, as I have been told.
- The biologists who have thus far been involved in the planning, and,in particular, those people who have formed the Monitoring Program Technical Committee (MPTC), are well-intentioned people who have simply lacked information.
- The Company is sincere in wanting to provide adequate information for the protection of the environment.

c) The objections are that the sampling procedure for phytoplankton was incorrect, the chemical data presented by Norecol are questionable, and the results obtained by the Mini-cleaner model are doubtful. The integrity of the baseline data collected so far is questionable.

(d) The suggestions are as follows:

- The Panel reserve judgement on whether or not the mine can be developed in a safe manner until the recommendations of the MPTC have been closely examined, and that I, or someone with equal or better qualifications be retained by the Provincial Government to provide them with information which they need to make the recommendations adequate and practical. Failing this, I would like an opportunity to examine these recommendations before the Industry agrees to the terms.
- The biological and chemical data for one year, complete with statistical validation be made available before the mine starts. Some of the variables measured during this year will be found to vary so much from one sample to the next that unless there is a very good reason for continuing the measurements, it should be stopped for these variables.
- The Company agree to concede that at some prearranged point, say a decline in either stream invertebrates or zooplankton of 15%, and in spite of the best of intentions and all possible efforts to the contrary, that it is impossible to mine this coal without destroying more of the environment than we can afford to lose.

(e) The request is as follows:

I wish to be made responsible for stream invertebrates, zooplankton, and lake benthos. Failing this, I request that the Company not be asked to waste money carrying out the recommendations of the MPTC.

Mr. Keays presented a second brief at the hearing, which also, essentially, took exception to the quality of baseline monitoring. He said he was trying to find out whether there was enough data to conclude that the mine could be, and would be, developed safely. He said that the type of bugs he was talking about had value in that they are food for fish, and, also, that they are most important in that, as life, they can tell us about the cleanliness of the water in a way which nothing else can. He was disturbed because he felt that a large percentage of the bugs which existed in the river and lakes would not be included in the baseline monitoring program. He also asked how many bugs would have to die before the mine would be shut down?

19) Mrs. Rita Kerr -

Rita Kerr gave the Commission the following information:

(a) She said that the development of the coal mine would conflict with the existing industries (i.e. forestry, tourism and fisheries), limit the potential for recreation and affect the expansion of the hatchery.

(b) This concern is not without precedent as coal mining is not new on Vancouver Island and its long-term, detrimental effects are evident in the loss of viable fish habitat in the creeks and streams in both the Cumberland and Nanaimo areas.

(c) In order to avoid these conflicts, she suggested that an integrated resource development plan be prepared for the Comox-Nanaimo coal fields, with emphasis being placed on the co-operative development of our forestry, fisheries, tourism and coal resources.

(d) The techniques prepared by Quinsam Coal Limited have never been tried on Vancouver Island before and the first mines will be experimental. They should be in areas where, if an accident does occur, any resulting damage will be minimal as to its effects on other resource users.

(e) She proposed that the Nanaimo Cowichan plan be extended to include all the coal reserves along the east coast of Vancouver Island. She also asked that the plan be prepared from input by the Department of Fisheries & Oceans, the Ministry of Energy, Mines & Petroleum Resources, the Ministry of Lands, Parks & Housing, municipal governments, regional district boards, mining companies, forestry companies, the tourist and recreational interests, and the public.

(f) One benefit to be derived from this plan would be the reduction of the type of conflict that has been created in the Quinsam River watershed because every resource developer will know, before they make development decisions, just where they are free to operate. A second benefit is we, as a society, will realize the greatest overall benefit from the development of all our natural resources.

20) Mr. Duncan Marshall

Mr. Marshall gave the Commission the following information:

(a) As one who worked the first twelve years of his working life in the coal mining industry for Canadian Collieries at the Comox coal fields, I owe much to the coal industry for the mechanical training I received, which was to help me for the majority of my working years, and for this I'll be forever grateful.

(b) However, I have seen events take place in my youth from mining that I would hate to see repeated in the Quinsam River system.

As a boy, my first memory of the Trent River at Royston was a river running rust colour and devoid of fish life. This condition as I remember would be from approximately 1920 on and was undoubtedly caused by the acidic content of water which found its way from the coal mines at Cumberland into the river itself.

(c) What worries me most is the thought that a government decision to issue the permits to strip mine, but stating that ample guidelines on mining to insure that no harmful effects could befall the Quinsam watershed, will be the end result of this hearing. We have seen the results of this type of decision in the area over the last number of years.

(d) The result of the Westmin mine pollution is that a recently released report on water quality as relating to fish was that all fish from the head pond to the south end of Buttle Lake are poisoned.

Less than two weeks ago, a newspaper release informed us that the mine on the Coquihalla River was guilty of allowing cyanide to escape into the river, poisoning fish life; - this, no doubt, after guaranteeing that an event such as this was impossible to happen.

(e) These are just a few examples of what damage can happen when a mining company, following government guidelines, is left to insure that complete protection will be given to the environment. It is just too great a risk to be taken.

I would submit that the only way that the water quality in the Quinsam chain can be sustained in its present state is that the application for permits of Quinsam Coal be refused completely.

21) Mrs. Ruth J. Masters

Ruth Masters gave the Commission the following information:

(a) I am described as an environmentalist. While I belong to some twenty groups all struggling for some environmental policies, I am appearing here as a private individual.

(b) My contention is that no matter how sincere the intentions of the applicant are, there is no possible way that a massive surface disruption by enormous machinery such as is planned can happen without introduction into the watershed of silt and whatever chemicals are present in the mined materials. It is defying reality to suggest any form of containment; it simply rains too much. Chemical neutralization as proposed introduces many unknowns.

(c) The Fish and Wildlife boys and the Lands Branch employees as well as Federal Fisheries are usually dedicated, well-qualified fellows. However, they are all understandably nervous about their jobs, and are muzzled. The RCMP will dissociate itself from environmental problems. All of these employees can be called off politically from above -- especially if the offending company has paid suitably into the coffers of the "right" party.

What I am saying here is - do not count on honest or fast enforcement if this mine turns out to be a dangerous polluter.

(d) If this mine is permitted to go ahead as appears inevitable, and the fish resource is decimated or obliterated as the result, there will be others like me who will say "I told you so - NOW WHAT?"

Compelling Quinsam Coal to post a bond in a frightening amount for reclamation and recovery is short of an ideal solution, but it could help.

(e) If mankind is going to survive, there is nothing in the world more important that FOOD. Coal is a non-renewable, highly polluting resource, while fish can, if handled property, go on forever.

22) Mr. W. P. Peterson

Mr. Peterson gave the Commission the following information:

(a) As long-time residents of this area, and relying primarily on sports fishing as the basis for our Company's livelihood, we are gravely concerned over the short and long term effects of the proposed strip mining for coal on the Quinsam watershed by Quinsam Coal. We are further concerned realizing that this is really a pilot project that could affect a 90-mile corridor from Campbell River to Nanaimo. In effect, a 90-mile long strip mine, a new industry that Vancouver Island can ill afford.

(b) One of the questions we must ask is what happens if all the proposed safeguards fail? Are we faced with further deterioration of our own natural renewable resources? The evidence of heavy metals in the Campbell River is already history. Are we ready to give up the balance of the environment on the remaining Quinsam watershed? Are we ready to give up the salmon from which we make our living? As a family and a company who makes their living from salmon fishing, and employs 125 people during the salmon season, we know we are not alone in our fears.

The Salmonid Enhancement Program is working, making up for past transgressions by poor logging and mining practices. It is not the whole answer, but an answer that will grow as this Province grows. Do we really need a new industry on Vancouver Island, a new industry with new problems at a time when we are still confronted with old problems, at a crucial time in our own economy and our own lives?

23) Mrs. R. E. Pengelley

Joan Pengelley gave the Commission the following testimony:

With all due respect to the proposals made by the Quinsam Coal Co. to prevent environmental damage, I have not heard of any assurance that it would be possible to return the river to its natural state, including the fisheries, should pollution occur.

A bond of a million dollars or more will not prevent pollution nor repair the damage if we do not have the technical knowledge to do so. Who can estimate the monetary loss in jobs and spin-off industry not to mention the decreased quality of the environment we now enjoy.

Natural disasters do occur. What might happen to the planned settlement ponds, etc. if we should experience an earthquake as we did in 1946?

With the Campbell River dead, together with little hope of reversal in the years to come, we must not consider mining in the Quinsam River watershed. Surveillance and supervision may or may not pinpoint and reverse an impending disaster.

24) Pacific Trollers Association

Guy Adams gave the Commission the following testimony:

The Pacific Trollers Association represents 450 troll fishermen on the west coast of British Columbia. We feel that we have a commitment in habitat protection as our livelihood comes directly from the salmonid resource. This resource is already overtaxed in B. C. We have seen severe salmonid habitat destruction and large loss of wild stock salmon.

With loss of wild stock salmon, we as troll fishermen stand to be the salmonid user group that suffers the most severe long-term effects.

We have seen the water quality of Buttle Lake greatly impaired since the start of mining activity on this system. All this with supposed environmental safeguards in place and supposed monitoring. We have an example of how well the guidelines were followed on the Buttle-Campbell system and would not want to see a repeat of these atrocities in the Quinsam system.

This brings us to the question of baseline data studies. Are they sufficient? Are they representative? Are they thorough enough? Are the existing guidelines for Coal Mining in British Columbia applicable to our coastal area, Vancouver Island salmonid producing streams in particular? Was salmonid system protection taken into consideration when the existing guidelines were created? In the event of any salmonid habitat destruction, will we see mining activities curtailed?

25) Regional District of Comox-Strathcona

Mr. Hudson, Chairman of the Regional District, gave the Commission the following information:

(a) The Regional District Board has asked to be heard so that its constituents, both in and out of the District of Campbell River, will have expressed a position through their locally elected representatives.

(b) The Board is a federation of municipalities and electoral areas which cover the area between Hornby Island at the southeast corner, the Brooks Peninsula to the northwest and Bute Inlet on the Mainland. The rural part is divided into 10 electoral areas. The municipalities which make up the rest of this entity are Campbell River, Courtenay, Comox, Cumberland, Sayward, Gold River, Tahsis and Zeballos. Campbell River is the largest and most populous.

(c) The Board has made various comments on Quinsam Coal since 1981, and I think it is fair to say that the stands taken have been virtually parallel to those taken by the Municipality of Campbell River.

(d) While the Board has continued to express a general concern, it has also specifically encouraged the implementation of a sophisticated monitoring system to provide a measure for comparison during the evaluation of the project and, should the project go ahead, during the operation.

(e) There is no simplistic capsule statement that could adequately describe to you the feelings of 18 people associated with the Board on such a complex problem. I do not recall any member being absolute as to whether the project should go ahead or be stopped. Each discussion was tempered by statements concerning the possibility or probability of being able to mine at that location without adversely affecting the environment, particularly the River. There was, however, one consistent theme and that was the assertion that no degradation of the River was acceptable. It seems that even the most optimistic description of the possible benefits of the mine were not seen as being worth damaging the Quinsam River and its fish.

26) Mr. William C. Rogers

Mr. Rogers gave the Commission the following information:

(a) He stated that the salmonid population of this area is in serious danger. This can be shown by the Provincial fisheries regulations in effect for the Campbell River, its estuary and the adjacent waters. The river itself is closed to angling for all salmon, and the adjacent waters have severe restrictions on angling methods and seasons. Also, it is a commonly accepted thesis that most of the salmonid fishes in this area are a product of the Quinsam River Hatchery: this includes trout as well.

(b) The Quinsam River has somewhat less restrictive measures in effect in that people are allowed to angle for some of the anadromous fishes. The chinook salmon are still protected by law from all angling. In fact, there are so few chinook left that they have to be netted and carried to the hatchery to be sure of obtaining brood stock. Obviously, there are no areas in either of the local rivers open to chinook fishing. The Quinsam River Hatchery is an indispensable part of the local salmonid enhancement program and it is dependant on the Quinsam River for its operation, the area which will be the most susceptible to pollution from the proposed coal mine.

(c) Mr. Rogers inferred that many mines in British Columbia had a poor environmental operating record, and as far as he was concerned, so did most industries. He felt that Quinsam Coal Ltd. would be no better. He stated that the reason industry polluted the environment was that they were more interested in profits than protecting the environment.

(d) He also questioned the suitability of the coal haulage route to Middle Bay. He believed that Quinsam Coal Ltd. should not be allowed to use the public roads (presumably he meant only for coal transportation).

27) River Sportsman Ltd.

Mr. MacKenzie's testimony was as follows:

River Sportsman is a sporting goods retail store that is located on the Island Highway immediately before the highway bridge crossing the Campbell River.

For a good many years, we have had the pleasure of serving both local people and vacationing tourists, whose hobbies include: fishing, hunting, canoeing, camping, hiking and other outdoor oriented activities. We are also the major local supplier of fishing tackle for the numerous guiding and charter businesses that operate throughout the year in and around the Campbell River area.

As people who are wholly dependent on the environment and the outdoor experience, we have had genuine concerns and certain reservations regarding the idea of the Quinsam Coal Development since its inception. I am sure that no one is more aware than we are of the importance of the Campbell/Quinsam watershed and its value as a multi-recreational use area.

We are speaking as people that have a business interest in Campbell River. But our biggest investment is in the environment and our greatest return is the opportunity to be able to remain in this "Sportsman's Paradise".

If this coal development is approved, we are afraid that it will be a TRADE-OFF that this community will regret forever.

For the fear that we have and for the statements we have made, River Sportsman Ltd. is willing to sacrifice the short-term gain and officially goes on record as being totally against the Quinsam Coal Development.

28) Mr. Kevin Rundle

Mr. Rundle gave the Commission the following information:

(a) He said that he had worked in open-pit mining and construction for eight years.

(b) He said that he had worked for Utah Mines in Port Hardy in mining operations and Teck's Bullmoose Mine at Tumbler Ridge on construction. His experience indicated that both companies were very concerned about environmental matters, and this was reflected in the fact that environmental awareness was stressed to all new employees coming on the job. Each company had programs and facilities to restrict pollution, and in his opinion, each company did a good job in this area of endeavour.

(c) He believed the Quinsam Coal Company would run their operations in a similar manner.

29) Society Promoting Environmental Conservation (SPEC)

Mr. Erkiletian gave the Commission the following information:

(a) We would like to see the Fish and Wildlife Branch of the B.C. Department of Environment submit an inventory of the local flora and fauna so we might determine possible effects of noise, air pollution, and increased access of hunters and others on the ecosystem.

(b) We are also very concerned with the possible degradation of the salmon hatchery and the habitat of the some 32,000 steelhead and wild salmon that live in this river system.

(c) We know that Buttle Lake is being degraded by heavy metal contamination due to the operations of Westmin Resources, and that the interaction of two sources of contamination can have a multiplier effect. A thorough study of possible effects to the lower Campbell River and the estuary should be undertaken before a second possible source of trouble be allowed to develop. Considering the importance of pure water, we suggest that no mining be allowed in the watershed anywhere above Campbell River townsite until the contamination of the Buttle Lake system is rectified.

(d) We express concern about the truck haulage route and can see no evidence that the Company can truck this much coal to Middle Point without changing the chemical composition of the corridor.

30) Steelhead Society of B.C.

Robert Bell-Irving gave the following information to the Commission:

a) In his evaluation of the Quinsam River fishing, he came up with the following figures:

i) Pinks - (based on 3 lbs/fish at 26¢/lb)

Annual Escapement @ 25,000 fish = $19,500

Downstream Migration @ 7,600,000 fish = $5,928,000

ii) Chinooks - (based on 20 lbs/fish @ $1.15/lb)

Annual Escapement @ 2032 fish = $46,736

Downstream Migration @ 1,500,000 fish = $34,500,000

iii) Coho - (based on 6 lbs/fish @ 66¢/lb)

Annual Escapement @ 22,399 fish = $88,700

Downstream Migration @ 2,500,000 fish = $9,990,000

(b) His evaluation of the salmon as sports fish was set at $8.00 per lb.

(c) He noted that the following facilities in Campbell River were dependent, or partially so, on the tourist trade and visiting sports fishermen:

Lodges - 7: Hotels-7: Motels - 15: Resorts - 10:
RV grounds - 2: Campgrounds - 3: Restaurants - 25:
and most of the other merchants to a lesser degree.

He suggested that the mine bonding should be set to compensate all of these people in the event of a negative impact from the mine.

(d) He indicated that bonding could not protect the spiritual and recreational aspects of the fishery.

(e) He also noted the value of the Federal Fish Hatchery, stating that it provided $250,000 annually in wages for its permanent staff and another 1199 work weeks for temporary staff. Its other expenditures in the Campbell River area were $193,000 per year.

(f) In closing his testimony, he wondered what the realistic ability of the Mines and Waste Management Acts really were to serve as a positive deterrent to possible negative impacts from the mine. To illustrate his point, he brought forward a witness, Mr. Sinnott, a lawyer, to discuss the details of possible protective measures and bonding under the provisions of both Acts.

31) Sierra Club of Western Canada

Shirley Duncan gave the following testimony to the Commission:

a) Despite changes made in mining plans over the past six years, we remain unconvinced that measures proposed for maintenance of water quality under all possible and probable climatic conditions will be adequate.

(b) We are also concerned about ecological changes in the Upper Quinsam and Gooseneck Lakes areas that may be wrought by changing water flow levels and patterns.

(c) If Quinsam Coal Company feels that we are being unduly pessimistic, we would remind them that they are inheriting a legacy from their predecessor in the area, Western Mines (now known as Westmin Resources) who, despite the expert advice of the day, has given us some most undesirable additives to our potable water supply. As the Quinsam River is the most viable alternative as a source of community water, it is not unreasonable that citizens are very touchy about its quality.

(d) Another point that particularly concerns the Sierra Club is the environmental bonding asked of the Company. Despite "legislation and responsible industrial practices", however strict they may seem to be, we feel that this bonding must be both long term, say 20-25 years on a gradually diminishing scale, as well as substantial enough to cover not only reclamation and waste management costs, but any environmental emergencies that could occur.

32) Tyee Club of British Columbia

Mr. Berger brought the following information before the Commission:

(a) The Tyee Club obtained its charter under the Societies Act in 1927. The purpose of the Club was to ensure that fair play was used in the fishing of the Tyee salmon. The Tyee Club has done much to put Campbell River on the map.

(b) The reason for the Tyee Club appearing at the hearing is to protect the Tyee salmon stocks.

(c) The Tyee salmon utilized roughly 1 ½ miles of spawning area within the Campbell River, leaving the Quinsam to other species of Pacific salmon. With the coming of Westmin's ore mining operations on the Campbell River system, there has been a steady but continuous decline in the numbers of Tyee salmon caught.

(d) Fortunately, with the installation of the Quinsam River Hatchery, a program to restore the Tyee salmon has been initiated. The hatchery program appears to be succeeding but the Club is now extremely fearful that with the installation of the coal mine, the new Chinook or Tyee runs will again be jeopardized. The Tyee will lose its second chance to survive.

(e) The Tyee Club does not wish the coal mine to proceed, no matter what priorities are given to the protection of fish.

33) The United Brotherhood of Carpenters and Joiners of America (Local 1882)

Mr. Fred Kuhn submitted the following information and questions to the Commission:

(a) The United Brotherhood of Carpenters have had representation in Campbell River since 1947, currently representing 180 members. It is affiliated with the Vancouver Island District Council of Carpenters and the Provincial Council of Carpenters. At our 1981 Provincial Council of Carpenters' Convention, a resolution was submitted by the Campbell River Local and it was passed and endorsed by the Provincial Council of Carpenters' Convention to oppose the Quinsam Coal Project.

(b) What assurance do we have that the two principal venturers of Quinsam Coal Ltd., being Brinco Mining Ltd. and Weldwood of Canada Ltd., will honour any debts incurred as a result of damage to the environment?

(c) Is Quinsam Coal Ltd. prepared to instruct the future employees fully on their job classifications as to exactly what their job duties are? We would like to ensure that Quinsam Coal Ltd. does as much to protect the environment as they would do to maximize their production and profits.

(d) Is Quinsam Coal Ltd. prepared to inform their future employees that they are working on an ecologically sensitive project and that if the level of contamination reaches an unsafe level, they may be forced back on to U.I.C. or Welfare until the problem is rectified.

(e) With regards to protection of the environment, we would like to see more continuous water sampling.

(f) With the Quinsam Fish Hatchery located downstream from the proposed coal mine, we are very concerned that none of the pollutants make their way down to the Hatchery as this will have a disastrous effect on the salmon fry and the jobs created by the Hatchery.

(g) We would like to state that the Carpenters Union does not support the Quinsam Coal project for the sake of creating a few jobs. This statement should not be misinterpreted in that we are concerned about the state of the economy and the high level of unemployment in the Campbell River area.

(h) We would, therefore, urge that Quinsam Coal Ltd. guarantee that the habitat of the fish and quality of the drinking water remain unaffected before Quinsam Coal Ltd. is given the go-ahead to start its operations.

34) United Fishermen and Allied Workers Union (Local 17)

Mr. Mike Murphy gave the following information to the Commission:

(a) The local membership is about 200 people and the provincial membership about 5000 people.

(b) Our members in this area have witnessed over the past 100 years a continuing degradation of fish habitat. This has been caused by residential, commercial, and industrial encroachments on estuaries, streams and beaches.

(c) In the event Quinsam Coal Ltd. should be allowed to mine, we believe that strict monitoring and bonding be established now.

(d) From a report by our own Provincial Government, it appears that the present value of the Quinsam River fishery is 224 million dollars. It would seem reasonable to bond Quinsam Coal Ltd. for this amount if they are allowed to proceed. Of this amount at least 5 million dollars should be posted as a cash bond before any production is allowed.

(e) Any reasonable person who has looked at this area, the size of the watershed, the low summer flows, and increased water temperatures, the low buffering capacity of the stream, the high rainfall, and the high sulphur content of the coal must come to the conclusion that if Quinsam Coal is allowed to proceed, we face a disaster.

35) Mr. Ronald Wilkins

Mr. Wilkins gave the following information to the Commission.

(a) He had been a former mechanic in the employment of Kaiser Resources Sparwood Coal Mine.

(b) From his experience in Sparwood during the early 1970's, coal mining was very crude as far as environmental protection was concerned.

(c) Since 1976, when he revisited Sparwood, the changes in coal mining operations with respect to reclamation and environmental protection, were spectacular.

(d) From his recent experience on the construction of the new Greenhill open pit coal mine in this Province, environmental protective measures have continued to expand and have come a long way since 1970.

(e) Quinsam Coal now proposes to build a coal mine in our area. I have studied this proposal, toured the proposed site, and talked at length with the people at the Quinsam office here in town. Quinsam has answered all of my questions and concerns and in my opinion, have done their utmost to alleviate the concerns expressed by all the various groups and Government agencies. In my mind, all concerns have been answered.

(f) He said that in his opinion and from his experience, there are enough safeguards and commitments from Quinsam Coal regarding the environment that he has no qualms in supporting this proposal at all. He is now a resident of Campbell River.

36) Vancouver Island Resources Society (VIRS)

The following individuals gave testimony to the Commission and their testimony was as follows:

Dr. Richard Murphy, M.D.

(a) In his opening statements, he gave a brief

VIRS (Dr. Murphy - Continued

history of his life and the organizations he had belonged to in the Campbell River area. He also said that he appreciated the easy, relaxed and sensible manner in which the Commission had conducted the hearing.

(b) This Society was incorporated in May 1983 with its main objective being to promote the harmonious use of natural resources on Vancouver Island. It is a non-profit, non-partisan organization and totally dependent on the generosity of its members in dedicating their time and money to its purposes. The Society developed out of the Save Our Salmon group which had been active for several years in preserving the Quinsam watershed.

The Society adopted their 455 members and undertook their objective as well as committing itself in the future to obtaining the best possible use of all watersheds on this Island.

(c) He said that he plans to get the best possible protection for the Quinsam watershed, particularly in view of the very poor current status of the Campbell as fish habitat. Our population here has increased from 2,000 in the forties to 15,000 in the eighties. Many of these people have come to work and live here because of their interest in fishing and the outdoor recreational opportunities. Campbell River's success ratio of 1.5 fish per boat per day was the highest in the province in 1975 (Bell & Thompson). The value of Campbell River's aquatic ecosystem is indicated in social terms by the fact that 85% of all tourists questioned said that water-oriented activities were the major attraction (Bell & Thompson). In Steelhead fishing the success ratio for the Quinsam stood at 0.432 fish per day in 1975-76 and this is significantly higher than the provincial average (Bell & Thompson).

Therefore, we are adamant in protecting established jobs in the tourist, fishing and logging industries as well as preserving the lifestyle and environment that is attractive to many retired people.

(d) Our Society is involved with the past, present and future activities of Westmin Resources. At the present time, we are witnessing the total annihilation of the world famous Tyee run in the Campbell. This particular stock of chinook were noted for their large size and consistency in withstanding heavy fishing pressures of previous years. One would be extremely naive to ignore the heavy metal contamination in this river as a factor in such a decline.

Possible future coal mines on the east coast of Vancouver Island is another issue of deep concern. We recognize that for the purpose of this inquiry, the Company has stated that only the area around Middle Quinsam Lake is in question. However, we must note that the other half of Quinsam Coal Ltd., i.e. Weldwood, have taken no part in these hearings and that they have extensive coal leases from here to Nanaimo. It would appear that Weldwood,which is basically a forest products company, is in an ambiguous position in the matter of resource use and coal port development on Vancouver Island.

(e) The hearing procedures were questioned, and some suggestions for their improvement were made.

(f) The major issue at this particular time is, of course, the Quinsam Coal Development.

(g) There are significant differences betwen the Widco mine and the proposed Quinsam mine which challenge the validity of the comparison presented by the Company.

(h) The coal dust problems do not seem to be adequately addressed either at the mine site, or at Middle Bay. There is concern about fugitive coal dust combining with the pulp and paper mill emissions with synergistic possibilities of grave import to the community.

It would be entirely reasonable that Quinsam Coal Ltd. should be requested to have in place in a few areas along the path of these westerly winds test containers to measure acid rain.

Another area of dust disperal will occur during transportation of the coal in uncovered barges. All types of barges proceeding south in the winter have their forward ends swept by waves and large amounts of coal could be displaced on to the water surface. There are no mitigative measures in place to correct a layer of coal fines in Discovery Passage between Middle Bay and Cape Mudge.

Dust at the mine may well be difficult to control as the lakes are relatively small, especially Long Lake, and their surfaces could be easily covered due to the variable summer wind conditions.

(i) Concern was expressed for the protection of blue grouse, as their flyway is directly through the mine site.

(j) The swamp at the head of Middle Quinsam Lake should be left undisturbed. This is excellent juvenile fish habitat. The effluent pipe from the settling pond should discharge into the main body of the lake where any effects of nitrate loading and/or sedimentation would quickly become apparent.

(k) We wish to stress the tremendous local anxiety which has focussed on the Campbell. Even in the good years, it was known that only a mile or two of spawning area was available in the Campbell. This was used by chinook and chum. On the other hand, there are 14 miles of spawning gravel in the Quinsam used mostly by pinks and coho.

(l) There are concerns in connection with the coal haulage route relating to density of traffic, the environment and safety. The following suggestions are made:

- Widening the present roadway in some areas.
- Establishment of access, passing and left-turn lanes.
- Construction of run-away truck lanes.
- Installation of traffic signals on at least 2 major highway crossings.
- Probable necessity to widen the winding road around Echo Lake. As this area, in our understanding, is principally hard rock requiring drilling and blasting, such construction could conceivably damage the water quality of Echo Lake and its drainage.
- Most of the above items would also apply to Highway 19.

(m) In addition, we would suggest, if this Commission and the various Ministries decide to proceed with the mining proposal, that all washed coal haulage to Middle Bay be confined to an industrial road complex with only two properly reinforced and safeguarded crossings of

Provincial highways: one on Highway 28 at the Comox logging bridge and the other on Highway 19-N at Duncan Bay Road.

Mr. John A. Brandon

(a) He told the Commission that he had a degree in Civil Engineering and advanced education in mines engineering. Further, he had extensive experience in mine operations (33 years), rising through various companies from mucker to surveyor to shift boss to Chief Engineer to Superintendent, and Mine and Project Manager. He further said that he had not mined for coal, but his experience included mining for copper, lead, zinc, silver, uranium, gold, tungsten and fluorspar, and that mining was mining, whatever the product.

He said that,as his resumé indicates,he is qualified to address the issues so far raised in this inquiry, with the exception of biological implications.

(b) One of the three main worries about the project is the business of sedimentation. Of all the problems to be addressed, this one perhaps is the most amenable to strict engineering design. The basic work by Ker, Priestman appears to be well done.

Concerns outstanding are as follows:

- Detail design of the baffling arrangement for water routing in the settling ponds.
- The use of macrophytes for nitrate uptake.
- Disruption of surface water ditches by beaver.
- If lime is added to the water to suppress acid mine drainage, will it adversely affect the flocculants?
- How will the problem of diesel oil, fuel oil and lubricant spills be taken care of?
- Breakdown of the flocculant material in the bottom of the settling ponds by disturbance of any kind with subsequent release of the material to the lakes and river systems.

(c) He notes that Mr. Pommen (Province) and Mr. Milner (Company) agree that probably 6% of the nitrogen in slurry explosives will be lost due to wet blasting conditions. Further, he notes that from the Company's testimony, only 1% of the ANFO will be lost. His estimate was that 5 percent of all explosive material would be lost.

From his calculations, he figures 624,000 pounds of ammonium nitrate from ANFO and another 26,000 pounds of nitrogen from slurries would be lost to the surface water management system. During cross-examination, the Company questioned the accuracy of these calculations.

(d) He questioned the reliability of acid base accounting in that it does not reflect with any degree of accuracy the conditions which will exist in mining. He further pointed out that the acid base accounting which has been done is inaccurate because it did not take into account the 5.492 million tons of rejects over the life of the mine, which will be high in sulphur content.

(e)He points out that the quantity of $CaCO_3$ available for neutralizing acid bearing rock will be substantially reduced from theoretical measurements because of the particle size of the blasted overburden of calcareous material. Because of the method of blasting stated by the Company, he expects this material to exist in large sizes in relationship to the acid bearing material, which, of course, would reduce the area of contact and thereby the amount of $CaCO_3$ available to go into the solution.

(f) He also points out a further consideration. Atmosphere Canada has estimated the condition of local precipitation to be a pH of 5.4 with an oxygen content of approximately 10.5 mg/L. This means that a portion of the neutralizing material will be soaked up in merely neutralizing the slightly acidic precipitation.

(g) In addition to the foregoing three points on acid base accounting and neutralization of acid material, he also stated the follow:

- The bulk of the backfill and sandstone will release its calcareous material reluctantly.
- Calcium Carbonate is only slightly soluble in cool water.

- Channelization of percolating water will reduce the amount of neutralizing material exposed to reaction to a significant degree.
- No one can make a prediction one way or the other on the basis of the material available.

(h) As far as the mine plan is concerned, Mr. Brandon stated that the easily identified shortcomings of the plan are as follows:

- No detailed plans of the shovel and truck pits have been presented.
- There is a strong doubt that the acid-generating rejects can be encapsulated and kept segregated in any of the pits in inclement weather.
- There is the strong probability that the acid-generating segments of the overburden cannot be accurately segregated in the shovel and truck pits, and practically no possibility of segregation in the dragline pits.
- There is the grave danger of slope failures in all the pits approaching 200 feet in depth, with subsequent spreading of the acid-generating materials at best, and catastrophic accidents at worst, if present plans are followed.
- Any major modification of the mining plans to gain slope stability would require large out-of-pit waste dumps.
- The size and activity of the equipment proposed will likely result in a major air pollution problem during periods of low stream flow.

(i) In his interpretation of the geological information presented by Mr. Brown, he stated that the possibility exists that Long Lake could drain into Pit 4S if vibration from blasting loosened ancient channels.

The uncertainty about which condition pertains arises because the area was not subjected to sufficient drilling to determine the presence and depth of these old, now filled channels.

He states that if he is correct in his interpretation of the geological data, the following could happen:

- Settling ponds 2 and 3, which sit on the Long Lake fault zone, could become inoperative.
- Under the influence of heavy blasting that can open ancient hidden channels, either Long Lake could drain into Pit 4S, or acid generated in Pit 4S could ultimately drain into the Quinsam River.

(j) In closing his testimony, John Brandon stated that in his opinion, based on his experience, if Quinsam Coal Ltd. meets all of its commitments to environmental protection, the mining operation is not economically viable.

Dr. J. A. McCarter, Ph.D.

(a) Dr. McCarter told the Commission that he received his Master's degree in Chemistry from the University of British Columbia, and his Doctorate from Toronto University. He has held a number of positions with research councils, and with Dalhousie University and University of Western Ontario, as Professor and Head of the Department of Bio-Chemistry. Since his retirement to Victoria, he has been associated with the University of Victoria's environmental toxicology program, and in particular, toxicity of heavy metals on salmonids. This program included studies in the Campbell River-Buttle Lake drainage area. He has also done some work with the Quinsam hatchery and the Pacific Biological Station in Nanaimo.

(b) It would seem to appear that the plans for burying the acid-generating rock beneath acid-consuming rock is a good plan. A concern, however, was expressed for acid generating material which would inevitably be left on the surface in the form of clean coal or coal dust, or unprocessed material during prolonged shutdowns. In order to take care of this probability, it was suggested that a lime-slurry tank, feeder and controls be included with the settling ponds to neutralize mine drainage water, if the need arose.

(c) Continuous automatic monitoring should be done for pH, conductivity and turbidity at the settling ponds.

(d) In connection with heavy metals, it would appear that the overburden and coal are not likely to be a significant source and, also, groundwaters are high in pH, which would decrease the ability of the groundwaters to carry concentrations of heavy metals in solution. Acid-leachates were not acutely toxic to fish. He wondered, however, what the chronic effect would be?

Toxicity of the water being discharged from settling ponds could be monitored on a continuous basis using Heath trays to expose eyed eggs of salmonids to control water,or to effluents through hatching to swim-up.

(e) It is noted that, as a result of the use of blasting materials, the concentration of nitrogenous nutrients in the receiving waters is expected to rise. This may not have a deleterious effect on water quality if, say, phosphate is limiting.

However, rather than guessing about whether or not the additional nutrients in the water may have a deleterious effect on water quality, experiments should be done to determine such effects directly. This could be done by placing suitable enclosures (CEPEX bags) in Middle Quinsam Lake. To the bags, one would add nutrient materials in the anticipated concentrations and measure, in the manner described in the August 4 report, the rate of algal growth. (August 4 report - "Baseline Data Collection and Monitoring Program for Quinsam Coal Limited".) This should be a prelude to issuing licences permitting nitrogenous wastes to enter the Quinsam drainage.

Another comment: the limit of detection of chlorophyll A is 0.5 mg/L and the concentration is now below detection limits when 1L of water is analysed. In the monitoring program, the volume of water should be increased so that the sample will be in a measurable range.

(f) On Pages 2-54 of Vol. II of the Addendum, it is said that the design of the settling ponds allows a conservative 10 h retention time - that 4-8 h is actually enough time for settling to occur to the 25 mg/L allowable limit for suspended solids, and that the retention time even in the 200-year storm will be 5.9 h. Note that in the test for toxicity of the supernatant fluid after flocculation of suspended solids, a period of 24 h settling was used. The experiment did not attempt to duplicate the field design.

The toxicity of Calgon M503 was measured by the Environmental Protection Service (under the direction of R. Watts) to be 8.5 mg/L for 50% mortality of rainbow trout in 96 h. Calgon M503 was selected over another flocculant because of the apparently lower toxicity of Calgon M503.

We have received a sample of Calgon M503 - the name has now been changed to M5352. The letter from Calgon-Canada to J.A. McCarter gave the toxicity of M5352 as 0.22 mg/L, i.e. the product is almost 40x more toxic than was reported in the tests conducted by the Environmental Protection Service. The letter goes on to point out that the toxicity of the flocculant is markedly affected by the turbidity of the water to which the flocculant is added.

Our comment is that the toxicity of agents used to flocculate suspended materials should be tested using actual receiving waters. The turbidity of water in the Quinsam drainage will vary during the year, but when it is clean, the toxicity of any flocculant that escapes entrapment in the settling ponds will be at a maximum in the lake or in the river. It is to be noted that the tests run by EPS were said to have been conducted using clean water - but so were the tests reported by Calgon. These discrepancies must be rectified.

It should be emphasized that the test whose results are reported used acute exposures lasting 96 h and measured the concentrations of toxicant required to produce 50% mortality. One really wants to know what concentration is safe. At a minimum,the ILL (incipient lethal level) should be measured using Quinsam water; that is, one should expose test animals for periods of one month to different decreasing concentrations of the toxicant so that a plot of mortality versus concentration gives the concentration at which mortality is incipient. Below this concentration, death should not ensue no matter how long the exposure. Even the ILL may not be sufficient because it is possible that other deleterious effects than death might follow chronic exposure to sublethal concentrations through the different life cycles of the test animal. In the Quinsam drainage, there are 5 species of salmonids and an important SEP facility at risk, so it is important to know that whatever is added to the water produces no deleterious effects. We think the evidence presented to date is not at all conclusive on this point. Further testing should be done.

(g) In general, we note the improvement in the steps proposed for monitoring and baseline data collection outlined in the report of August 4, 1983. However, it is clear that all of these steps to be taken address a situation after it has happened and nowhere is there information on what remedial steps can be taken after, for example, there is an algal bloom, or an increase in metal levels in tissue of fish. Surely, it is important to address the problems that might arise by continuous monitoring of key parameters, to take immediate remedial action, and to assess over a long period of time, as proposed in the report, changes that might occur subsequent to the polluting events. Concern about toxicity of discharge from the mine is central, so direct measurements of toxicity of these discharges on an ongoing basis should be undertaken. Had there been, from the time of startup of Westmin Resources monitoring of the discharges into Myra Creek, the problem of acid generation from waste rock piles would have been discovered 10 years earlier than it was.

In any event, all of the background data and the description of sampling procedures should be published. Annual reports should be submitted to the Monitoring Program Technical Committee to determine the adequacy of the data being collected.

Mr. Robert M. Hershey

(a) He told the Commission he had a B.S.degree in Geological Sciences and a Master's degree in Environmental Pollution Control. He further stated that he had continuing education in hydrology, groundwater pollution and water pollution in coal mining operations.

(b) He told the Commission that he had some nine years of experience which included geological, hydrological, sewage and pollution control studies for government and industry, including coal mining companies.

(c) He noted that Quinsam Coal Ltd. had performed several pumping tests to obtain hydraulic conductivities in order to calculate the natural groundwater flows through the proposed mine site. The Company reported that no large conduits of groundwater flow could exist since no recharge boundaries were observed in the pumping tests.

After looking at the natural recharge of the pits, he questioned whether the hydraulic conductivities calculated were representative of each overall pit area. He said that he calculated a recharge rate of approximately 0.6 US gpm/acre (1.2Igpm/ha). Using 47 inches of rainfall per year and 40 percent infiltration rate for the backfilled mine, the ground water flow from recharge over the 1S pit area would be 11.5 US gpm.

Assuming 1500 acres is going to be mined, then a conservative total recharge rate for this area would be 900 US gpm, which is approximately 3½ times more water than the 205 Igpm predicted by Quinsam.

On this basis, he accuses Quinsam Coal Ltd. of failure to appreciate the importance of bedrock fracture-controlled groundwater flow.

(d) The overburden sampling done at the proposed mine site is inadequate to assess the potential acid production. Sturm Environmental Services (SES) on Page 15 of their September 1983 report states that one would expect at least tenfold the amount of geochemical data as presented for this type of project. More locations should have been sampled within the proposed mine area and smaller thicknesses should have been sampled within the length of the drill holes.

(e) Overburden analysis is only one tool in predicting the potential for acid mine drainage. The best predictive mechanism is to look at the quality of surface water and ground water from a mine in the same setting on the same coal(s) and utilizing the same mining procedures. In this case, we do not have this opportunity.

As Sturm stated in their September 1983 report, "no single, simple set of controlled variables in the laboratory can be expected to predict what will happen in a particular field situation". I am not aware of any conclusive research which allows prediction of the level of alkaline material necessary to preclude or prevent acid mine drainage in overburden having 2 to 4½% or more pyritic sulfur, such as is found in the overburden at this proposed site.

(f) The overburden analyses submitted by Quinsam to this Inquiry have very large sampling intervals. There is some question as to whether the "low to moderate" levels of neutralization potential (N.P.) measured at the Quinsam site are even chemically available to the system. For example, Sample 9 from P-6-1C might suggest that an N.P. of 51.7 tons $CaC0_3$/1000 tons would neutralize the 1.60% pyritic sulfur (equivalent to 50.0 tons $CaC0_3$/1000 tons), but many experts feel that it probably will not.

(g) The only way a mine with the potential acid production of the Quinsam site could operate without producing acid drainage would be to utilize a detailed mining plan based on extensive overburden analyses and leaching studies. This plan would have to consider spoil segregation, blending, encapsulating, and other special-handling techniques. If a plan could demonstrate that it was cost-effective and would prevent acid mine drainage, then some assurance would have to be made that it could be implemented properly in the field. Continuous supervision on the site by a knowledgeable person in special-handling techniques would be critical.

(h) Quinsam has not proposed any groundwater monitoring points. This is unthinkable for an operation covering 1500 acres. If any springs, seeps or discharges exist down-gradient from the proposed mine areas, they should have been identified and sampled monthly for at least six months before any mining begins, and at least quarterly during the mining operations. Monitoring wells should be drilled to the lowest coal to be mined to supplement the other monitoring points. At a minimum, monitoring should include analyzing alkalinity, acidity, pH, sulfate, total dissolved solids, iron, manganese and aluminum.

(i) Sturm's review of the project appears to be fairly complete and contains some good recommendations such as the need for additional overburden analyses.

(j) Bedrock faulting is much more extensive on the Geological Survey of Canada map of the Comox Lake area than is shown on the Quinsam structure map.

(k) The report of Al Bruynesteyn,dated October 7th, 1983, contains an equation on Page 4 that supposedly represents pyrite oxidation. He states that 10 mg/L of oxygen could not produce more than 8 mg/L sulfate, because groundwater would not contain more than 10 mg/L of dissolved oxygen. This demonstrates a total lack of understanding of acid production from pyrite in a coal mine setting.

Dr. Barry Phelps, Ph.D.

(a) He told the Commission that he had a Ph.D. in Mining Engineering and taught courses in mining engineering, including coal mining, at the Pennsylvania State University. He belonged to six professional associations and had produced some thirteen publications on mining, including some on coal.

(b) He told the Commission that as well as teaching mining engineering for six years, he had had some eleven years of practical experience in the mining operations of various mining companies.

(c) From Dr. Phelps' review of the information concerning the area to be mined, he rates the area as a high sulphur property with low to high neutralization potential, certainly not a property for which a permit could be summarily issued. With this in mind, he makes the following comments in connection with this mining plan:

- Outside Dumps

He includes the dragline box cut spoil for both north pits as outside dumps because both of these dumps are to stay in place. None of the four outside dumps will have the stated advantage of a rejuvenated groundwater table to cover buried toxic materials. All of these dumps appear to have preparation plant refuse and potentially toxic spoil buried in them. Since the outside dumps will be either built in 20m lifts or by dragline, no significant reduction in porosity through compaction or selective placement of the toxic material appears possible.

Oxidation of pyrite, mobilization of these products, and therefore generation of acid mine drainage (AMD) from the dumps seems possible.

- Backfill Spoils

Selective placement of the toxic overburden and preparation plant refuse will take place in these spoils. The selective placement zone will be in the most porous zone of the backfill and therefore be subject to the maximum amount of oxidation and water contact. The selective placement zone will be subject to unrestricted air flows as the most porous zone acts like a chimney.

The selective placement zone is also ideally situated to obtain maximum contact from waters moving through this same highly porous "free draining" zone. Since there is no compaction of the selective placement zone, water and air, the two major agents required for pyrite oxidation, will move through it easily and readily.

In addition, there is serious doubt as to the stability of the dragline spoil as it is shown in cross section in the Quinsam Coal Company's evidence.

Safety factors equal to 1.30 are required by the U.S. Office of Surface Mining. Mining and civil engineers usually design non-permanent slopes such as those in strip mines to a safety factor of 1.60 or greater.

If a slope stability analysis is made on the spoil, it can be shown that the safety factor is at best about one and under a more realistic set of assumptions, is less than one. This means the slope as shown has failed.

Of course, if the slope has failed, then any selective placement which has taken place has been for naught.

- Final Highwalls

There is a dearth of information on what precautions are to be taken regarding exposed pyritic zones, in overburden and coal, which will remain in all unmined highwalls in each pit. Some of these highwalls will be close to groundwater discharge zones into some of the streams and lakes. This proximity is as close as 100 meters for both north and south pits. Such exposures could have adverse environmental impacts.

- Selective Overburden Removal

The typical mining plan cross-sections do not indicate selective blasting and benching in the overburden to remove the zones of high sulfur content. Since blasting of non-sulfur and sulfur bearing strata will take place at the same time, there will be little chance to perform selective removal and therefore selective placement of the high sulfur layers of overburden. Mixing of the overburden rock will take place under this mining procedure. Therefore, such a blasting and removal sequence negates all discussion of any selective placement of a specific overburden layer.

- Haulroads

The potential for erosion from haulroads as compared to natural vegetated landscape is tremendous. Values of 2000 times as much potential are reported (Clar and Mills, 1976). Therefore, erosion control and maintenance of haulroads is very important in an overall mining plan.

The Quinsam Coal mining plan calls for a high level of haulroad use in transportation of coal to the preparation plant facilities, in returning large tonnages of fine and coarse plant reject to the north pits, and in till management. Almost all of these haulroads to be used are outside of the erosion and sediment control structures shown on maps or discussed in the text. These haulroads are substantial in length and width and cross or are adjacent to the sensitive rivers and lakes in the area. Rainfall runoff from them will take place and will run directly into these streams and lakes.

(d) In closing, Dr. Phelps summarized as follows:

- There will be a great deal of potentially toxic material buried in four outside dumps.
- Spoil slopes within the pit appear to be unstable and therefore failure will question selective placement procedures.
- Selective placement of toxic overburden will be impossible to achieve without selective blasting.
- Exposed toxic strata in highwall faces do not have a reclamation plan.
- There are no erosion control measures taken for the extensive out-of-mine haulroads.

In addition to the foregoing, the Vancouver Island Resources Society made a considerable number of recommendations concerning the proposed mine operation. These recommendations are now presented in total.

RECOMMENDATIONS

General Comments:

We believe that at the termination of this hearing, the Commission can only bring in a negative report on this mine proposal. There are too many deficiencies in Quinsam Coal Ltd.'s submission. The lack of a detailed mine plan is enough to postpone a decision. It is interesting that in the case of the Centralia Coal Mine, "exploration was started in 1957 to determine the extent and quality of the coal and to acquire necessary land and mining rights and government permits." * The first production from this mine took place in 1971. "During the exploration and development period, the need for power increased and 'start-up' was advanced approximately a year and a half." *

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* The Centralia Coal Mine - Paul L. Vandeveer

The development and implementation of a good surveillance and implementation programme and particularly the people who should be involved in the work and its interpretation has not been adequately addressed. Furthermore, there are no indications who should act, when, where and how in the event of adverse indices affecting the environment. We are well aware that in the event of a major disaster, the Minister of the Environment can act. However, the far more likely possibility is that of a creeping disaster and under our laws at present there is no mechanism in place to address such a situation.

The monitoring programme during construction and operation lacks baseline data and is inadequate as to frequency, location and other parameters.

There is no evidence of the willingness of Quinsam Coal Ltd. to undertake reasonable bonding. Their offer of a million dollar bond is a mere drop in the bucket.

Specific Points:

1. Our first recommendation is for a moratorium of at least one year. This should allow enough time so that the major deficiencies such as baseline data, monitoring, detailed mine plan, bonding, etc. can be more fully addressed.

2. The report of this Commission to be made public within 30 days of their submission to the Minister.

3. There should be established as soon as possible a separate set of Coal Guidelines for Vancouver Island. These should be based on the following:

   (a) Existing guidelines may possibly be suitable for the larger land mass of the mainland but inadequate for an island, particularly one with a multitude of short rivers and streams with low buffering capacity.

   (b) Back in the early sixties, Mr. W.A.C. Bennett stated that Vancouver Island was unsuited for industrial development except that in relation to tourism, fish and trees.

   (c) Should development proceed on the non-renewable resource, a tax should be levied on the developer in sufficient amount to provide mitigation for the potential maximum amount of damage on the same watershed as the area being developed.

   (d) Public inquiry in Stage II so that all aspects can be discussed.

   (e) Future value of Vancouver Island coal for its chemical or other uses in Canada.

(f) Highly productive fish habitat should be excluded until such time as future technological developments could render such an operation to be totally compatible with the environment.

4. If mining proposal approved, all washed-coal haulage to port loading facility be confined to an industrial road complex.

5. We recommend the establishment of an Advisory Review Committee to the Minister of the Environment to consist of one member each from Environment Canada, Federal Department of Fisheries, Provincial Waste Management, Provincial Ministry of Mines, District of Campbell River, Quinsam Coal Ltd. as a non-voting member, and the Campbell River and District Environmental Council.

   As far as possible, the members of this Committee should reside in the Comox-Strathcona Regional District.

   The Committee should meet monthly during the first year of construction and operation and thereafter quarterly review all monitoring reports and/or any other environmental problems relative to the operation.

6. Bonding should consist of the following elements:

   (a) Initial cash bond of $1,000,000 before construction begins.

   b) Four percent (4%) of gross sales be set aside to build up the cash reserve to $5,000,000.

   c) Any expenditure from the reserve to be replaced at 4% rate.

   (d) Interest applied to build-up of reserve, but returned to Company annually when reserve stands at $5,000,000.

   (e) Maintenance of the Fund for five years after operation ceases.

   Net fund after credit for interest and charges for mitigation be returned to the Company in full.

7. The $2500.00 bond per hectare currently in place for reclamation is totally inadequate in view of the fact that at the Centralia Mine, it cost $5000.00 U.S. per acre in 1981. *

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* Personal communication - John Wisch

Minesite:

1. Short interval sampling of in-pit core drilling.
2. Establishment of a procedure for identifying and segregating potential toxic material which is scattered throughout the overburden.
3. A plan to control sedimentation and erosion from haul roads to mine area.
4. Any springs, seeps or discharges down gradient from the proposed mine should be sampled monthly for six months prior to start-up and quarterly during operations.
5. Lime addition plants to be in place before damage occurs.
6. Further studies should be directed towards containment of toxicity and final disposal of the out-of-pit dumps which now appear to be much larger than previously anticipated.
7. A comprehensive drilling programme east of Long Lake between pits 4S and 5S should be required to determine the structural complexity in this area, and to delineate potential water conduits which could possibly drain into the waterways or the pits.
8. Effluent pipe from settling pond #4 should discharge into Middle Quinsam Lake.
9. All vehicles from the mine site areas using the public highways to be washed.
10. No permits be issued until results of column leaching tests are known.

Monitoring:

1. Continuous monitoring of effluent for pH conductivity and turbidity.
2. Toxicity of water being discharged from settling ponds should be monitored on a continuous basis using Heath trays.
3. Placement of CEPEX bags in Middle Quinsam Lake to determine effects of nitrogenous compounds and phosphates.
4. Further testing should be done on the toxicity of flocculating agents using the actual receiving waters.

Haulage Route:

In the event Highway 28 is used, the following should be adopted:

(a) construction of run-away lanes;

(b) installation of traffic signals at major intersections;

(c) establishment of a left turn lane at junction of Highway 28 and Comox logging bridge;

(d) improvements to road at Echo Lake.

Middle Bay:

1. There should be mitigative measures in place in the event coal dust around Middle Point, either air or water borne, would make this favourite sport fishing area inoperable.

2. The very serious effect coal dust deposited on the chip barges anchored within 400 yards of Middle Bay should be addressed.

3. The added potential problem of dust between Middle Bay and Cape Mudge and points south during transport should also be addressed.

4. Establishment of acid rain test sites south of Duncan Bay.

Conclusion:

We believe it would be a travesty on justice to approve this mine operation until all doubts have been expelled in regards to the many and serious concerns expressed by the intervenors of this inquiry.

The burden of proof rests clearly on Quinsam Coal Ltd. to demonstrate their capability of mining without damage to the watershed. This they have failed to do,and,in fact,it is not surprising as the following quote from the Environment Ministry shows:

VIRS (Recommendations) Concluded

> " In our view, to segregate acid mine wastes and render them environmentally safe over the long term will require a degree of operational control that no coal mine in this Province has yet demonstrated" . (August 16, 1983).

THE FEDERAL GOVERNMENT'S PRESENTATION

SUMMARY OF THE FEDERAL GOVERNMENT'S PRESENTATION

A five-member panel appeared before the Commission, comprised of personnel from both Environment Canada and Fisheries & Oceans Canada. They gave the following testimony: (Commission's Summary).

1) The Quinsam River is accessible to all five species of Pacific salmon and sea-run trout from its junction with the Campbell River to the cataracts approximately 12 km upstream. Coho salmon and anadromous trout are able to migrate as far upstream as an impassable falls approximately 2 km below Middle Quinsam Lake. Natural escapements to the Quinsam River of all species of salmon have averaged nearly 16,000 fish over the past 12 years.

2) The Quinsam River Hatchery, which is located about 3 km from the mouth of the river, operates on two distinct strategies. The first is incubation and rearing of ocean ready smolts and the second is release of fingerlings to natural rearing areas presently inaccessible to anadromous fish. This includes areas directly adjacent to the proposed mine development. The total production of adult salmon from the Quinsam Hatchery has been about 250,000 fish (chinook, coho, pink and steelhead) annually.

3) Waters of the Quinsam system exhibit the quality of a virtually undisturbed natural system. There is little buffering capacity and low levels of suspended solids. The water quality and flow characteristics necessitate stringent control of any effluents discharged into the system and the critical evaluation of outfall locations in order to ensure the protection of fish and other aquatic organisms. Natural low flows in tributary streams in the mine site area may not provide sufficient dilution of proposed effluent discharges.

4) The proposed approach to sediment control at the proposed development site incorporates standard sediment reduction techniques and is designed to minimize sediment losses from the operation. Stringent effluent permit limits for levels of suspended sediment are warranted by the need to protect a sensitive and

valuable receiving environment. Most important is the successful implementation of a water management plan by the proper construction of facilities, diligent attention to maintenance and monitoring, and rapid modification of the plan and facilities if dictated by actual site conditions and mining practices.

5) The proposed Quinsam Coal mine would result in significantly elevated levels of dissolved nitrogen in the receiving environment of the Quinsam River system. This could result in serious negative impacts on biological communities and fish populations in the system. A review of nutrient data provided by Quinsam Coal Ltd. suggests that either the Quinsam system is severely nitrogen limited, or the phosphorus and inorganic nitrogen data are inaccurate. These data are thus considered to be of little value in predicting the potential impacts of nutrients on the Quinsam system. Because these data were utilized in modelling exercises to predict impacts of mining activity, and because insufficient information on expected phosphorus loads was provided, the predictions of the models cannot be considered valid. The expected responses of the Quinsam system to effluent discharges cannot be determined without more precise information on background nutrient levels in the system and a quantitative assessment of proposed phosphorus loads to the system. Detailed information regarding effective nitrogen control techniques remains outstanding.

6) The discharge of acid mine drainage from the proposed mine development could have serious effects on receiving water quality and fisheries resources in the Quinsam system. The acid generation issue at the proposed Quinsam Coal operation can be assessed and conclusions and recommendations developed using an approach which includes the gathering of data and preparation of a mining plan, preparation of an assessment of risk, and formulating a contingency plan. Outstanding required information includes the results of the leaching tests currently underway and critical examination of the mining plans, risk assessments and contingency plans currently being developed by an expert in the field of acid mine drainage.

7) The formation of acid mine drainage would result in elevated concentrations of heavy metals which, if not adequately treated before discharge, could adversely affect the receiving water environment of the Quinsam system. Since it is difficult to predict the levels likely to occur in the effluent under both acid and non-acid conditions, mitigation techniques and contingency plans for the control of metals would be required before development proceeds.

8) The baseline data collection program developed by the Company is generally satisfactory. However, this brief identifies a number of items such as additional sampling locations and parameters not yet included in the program. Construction and operational monitoring have yet to be addressed. The surveillance and supervision plans developed by the provincial agencies in conjunction with the company will be supplemented by federal agencies performing an audit role with respect to the protection of federally managed resources.

9) There is a requirement for performance bonding under both the Provincial Mines Act and Waste Management Act. Bonding must be set at a level which will ensure that reclamation can be completed, and waste management programs maintained until the site reaches a stable, self-regenerating state. The form of security chosen for the bond under the Waste Management Act must provide rapid access to the funds, if required.

10) The construction and operation of the barge-loading facility at the site proposed should not affect fish, fish habitat or migratory birds. However, a review of final detailed construction and facility operation plans will be necessary.

In addition to the foregoing statements of fact, and positions taken in regards to the Quinsam Coal Development, the Federal Agencies also provided the Commission with the additional following information:

1) Environment Canada considers that there are no "safe" levels of pollution, but rather "acceptable" levels of risk, the determination of which involves social, economic, and environmental consideration by society.

2) The Federal legislative authority to control discharges to watercourses is found in Sections 33 to 33.4 of the Fisheries Act. The Act prohibits the deposit of substances which are deleterious to fish, fish habitat or man's use of fish. The Act also provides authority to make regulations prescribing deleterious substances and authorizing the deposit of a specified amount of deleterious substances.

3) The Federal Agencies usually work through the Provincial Waste Management Branch's permit system. This process is a means whereby compliance with the Federal requirements, or their equivalent, may be attained, utilizing the concept of a "single window approach" when dealing with pollution. It carries the understanding, however, that when the Federal requirements cannot be accommodated by the Provincial system, separate implementation action may be taken.

4) The Department of Fisheries and Oceans have traditionally reviewed and provided comments to the Provincial Water Rights Branch on the acceptability of water licence applications for water intakes located on salmon-bearing waters. This review process also applies to water supply systems for proposed mines located on salmon bearing waters.

5) The estimated annual catch of naturally produced stocks of fish in the Quinsam River and of current (1980) hatchery produced fish are 24,000 and 149,000 salmonids respectively to the Canadian commercial catch. In addition, the estimates for natural stocks of steelhead and sea-run cutthroat trout are 450 and 268 respectively to the Canadian commercial catch. The dollar value of these stocks of fish is as follows:

Canadian Commercial Fishery	998,000
Sport Tidal Waters	1,393,000
Sport Fresh Waters	83,000
Native Food Fishery	200
Total	$2,474,200

Tables 1 and 2 on the following page provide details of the Canadian catch and estimated values of salmonids produced in the Quinsam River.

FIGURE 9

TABLE I - ESTIMATED ANNUAL CANADIAN CATCH OF SALMONIDS PRODUCED IN THE QUINSAM SYSTEM (1980)

	Canadian Catch from Natural Production	*Canadian Catch from Current Hatchery Production*	*Total Production*
	pounds of fish	*pounds of fish*	*pounds of fish*
Chinook	*907*	*24,711*	*25,618*
Coho	*7,025*	*89,180*	*96,205*
Pink	*14,940*	*33,780*	*48,720*
Chum	*484*	*0*	*484*
Sockeye	*100*	*0*	*100*
Steelhead	*450*	*800*	*1,250*
Cutthroat	*268*	*0*	*268*
Totals	*24,174*	*148,471*	*172,645*

TABLE 2 - NET VALUE OF THE CATCH OF QUINSAM SYSTEM SALMONIDS IN CANADIAN FISHERIES (1981 DOLLARS)

Fishery	*Value of Canadian Catch From Natural Production*	*Value of Canadian Catch From Hatchery Production*	*Total*
	1981 Dlrs	*1981 Dlrs*	*1981 Dlrs*
Commercial (wholesale value)	*139,000*	*859,000*	*998,000*
Native	*200*	*-*	*200*
Sport Tidal	*93,000*	*1,300,000*	*1,393,000*
Sport Fresh	*19,000*	*64,000*	*83,000*
	251,200	*2,223,000*	*2,474,200*

The ratio in value of naturally produced fish to hatchery produced fish is $251,000 to $2,300,000.

The employment figures for the commercial salmon catch of the Quinsam system are approximately 12.1 direct person years and 54.9 indirect person years.

The results of a 1979-80 Tidal Diary Program carried out by theDepartment of Fisheries and Oceans indicate that there were 19,000-23,000 active tidal sport fishermen in the Comox-Powell River-Campbell River area during these two years. This represents between 29% and 35% of the local adult population. This compares with 12-14% for the B.C. population overall.

6) The critical existing water quality and flows of the Quinsam System indicated the following:

   a) Mean Values of pH ranged from 6.88 (culvert outflow of Flume Lake) to 7.50 (inflow to Middle Quinsam Lake)

   b) Suspended Solids from samples tested indicated 90% below 1 mg/liter.

   c) Dissolved oxygen concentrations, as expected, tended to decrease with temperature increases. At some sites, the reduction in dissolved oxygen was considerable. For example, in August, 1983, a dissolved oxygen concentration of 5.7 mg/liter was recorded at the Flume Lake outlet site downstream of which a major settling pond discharge is proposed.

   d) The Department of Fisheries & Oceans' study results (DFO 1983) indicated that minimum flows occurred at most sites in late May or June 1983. This appears to be atypical as minimum flows would normally occur in summer. Nevertheless, in the period March 1 to August 15, 1983, flows as low as 0.012 m^3/s (0.42 cfs) and 0.523 m^3/s (18.5 cfs) were recorded for the outlet of Long Lake and the inflow to Middle Quinsam Lake respectively. These are areas of particular concern since proposed effluent discharges would be made directly or indirectly into these watercourses.

Information on settling pond discharge volumes and river flows in Norecol (1982) suggest that pond discharges could constitute a considerable proportion of the total Quinsam River flow below Middle Quinsam Lake at certain times of the year. The dilution of settling pond discharges which would enter Long Lake and Middle Quinsam Lake, and thence the Quinsam River, would depend upon the volume of discharge and the physical characteristics of both the discharge and the receiving water at the time. Under low flow conditions, good mixing cannot be assured. Accordingly, given the potential minimal dilution of settling pond discharges, stringent control over the quality of effluents discharged into the system is of paramount importance. Reductions in effluent quality, especially during periods of low flow, could have serious negative impacts on fish production.

Furthermore, it is clear from the recent DFO data (DFO 1983) that the Long Lake system into which two of the three effluent discharges are proposed would have even less capacity to dilute effluent. These data indicate that the flow at the Long Lake outlet "can ...be very low for extended time periods. In fact, this system flowed at less than 0.5 cubic feet per second (0.014 m^3/s) for the 26-day period between May 25 and June 20, 1983. Even at the peak of the coho smolt migration (May 5 to May 25) the water flow averaged only 2.67 cubic feet per second (0.076 m^3/s)."

7) The deposition of excessive fine sediment on the bottom of lakes and streams can eliminate habitat for aquatic insects; reduce the density, biomass and diversity of aquatic insects; reduce the permeability of spawning gravels, and block the inter-change of subsurface and surface waters. The effects of suspended sediment on the aquatic system are more direct. Photosynthesis may be reduced because of reduction in light penetration, fish migration may be affected; fish may not be able to feed efficiently under turbid conditions and suspended solids can interfere with efficient respiration. Young salmonids are particularly susceptible to gill irritation

caused by turbid waters, which in turn, exposes them to infection by fungi and bacteria.

Unless a catastrophic event occurs (eg. complete loss of settling pond's contents), it is unlikely that suspended solids levels would be sufficiently high to cause direct fish mortalities. Given the naturally very low levels of suspended solids (ie. <10 mg/l) in the Middle Quinsam and Long Lake system, any discharge containing suspended solids in excess of 25 mg/l could affect biological productivity in the receiving waters depending upon the total load of solids introduced, the chemical characteristics of the solids, and dispersion characteristics within the lake-river system. These effects could be either short-term or long-term depending upon whether the material is flushed out of the system during high flows or remains in the systems as deposited sediment.

8) Suspended solids levels are usually controlled in mining effluents in North America. The U.S. Environmental Protection Agency requires that the maximum suspended solids level for coal mine discharges on any one day must be less than or equal to 70 mg/l and the average daily value for 30 consecutive discharge days must not exceed 35 mg/l. Overflows from the treatment facilities resulting from a one in ten year 24-hour precipitation event or greater are not subject to those standards. The Province of British Columbia's Pollution Control Objectives for the Mining, Smelting and Related Industries (1979) provide for a range of possible maximum discharge concentrations from 25 to 75 mg/l. The more stringent value (25 mg/l) is to apply to sensitive environmental situations. Intermediate values may also be applied. The Federal Metal Mining Liquid Effluent Regulations and Guidelines (MMLER&G),although not applicable to coal mines, require that the maximum concentration of suspended solids in a grab sample must not exceed 50 mg/l and in a composite sample must not exceed 37.5 mg/l, and the monthly arithmetic mean must not exceed 25 mg/l. The MMLER&G are issued under the Fisheries Act and their intent is to protect fish and other aquatic life from the discharge of deleterious substances in effluents from base metal, uranium, and iron ore mines. Those regulations and guidelines apply uniformly across Canada as national baseline standards.

9) Effluents from coal mining operations generally contain elevated levels of dissolved inorganic nitrogen compounds, most of which are derived from nitrogen-based

explosives used in blasting. In contact with water, nitrogen compounds are leached from the explosives and from nitrogen products produced during detonation. The nitrogen compounds consist primarily of nitrates, with smaller concentrations of nitrite, ammonia and ammonium. Levels produced in any mining operation are expected to vary depending on weather conditions, groundwater and surface drainage characteristics, amount and type of explosive used and operational control over blasting activities. These nitrogen compounds can be toxic to fish and other aquatic organisms. The major concern, however, at the proposed Quinsam Coal operation pertains to the effects of elevated nitrate concentrations on primary productivity (phytoplankton and periphyton growth) in the Quinsam system. Minor increases in algal productivity could enhance overall fish production in the system. However, major shifts in nutrient supply with resultant excessive algal growth and biomass accumulation could have negative impacts on water quality and fish production. In lakes, shifts in phytoplankton species composition from small ultra and nanoplankton to large green and blue-green algae with associated changes in zooplankton production and community structure would be expected to occur. Problems such as sediment phosphorus release associated with reduced dissolved oxygen concentrations could have serious consequences in the Quinsam system, especially with the expected elevated concentrations of dissolved nitrogen. Low concentrations of dissolved oxygen could also negatively impact upon fish and other aquatic organisms. Excessive periphyton growth in the Quinsam River could affect salmon and trout spawning areas by clogging gravels and modifying benthic invertebrate communities through shifts in algal species composition. Periphyton accumulations could result in lowered dissolved oxygen concentrations in interstitial waters with accompanying impacts on benthic invertebrates. Elevated nutrient levels in waters used by the Quinsam hatchery could lead to specific problems within the hatchery such as excessive algal growth in salmon rearing channels.

10) Based on the chlorophyll data collected by Norecol (1983 a) the productivities of Middle Quinsam and Long Lakes can be classified as extremely oligotrophic. In the absence of physical constraints (light, temperature, lake mixed layer stability) on phytoplankton production, it can be concluded that lake productivity is nutrient limited. There are three fundamental questions to be answered:

a) Which nutrient or nutrients currently limits the autotrophic and heterotrophic production of the lakes and streams?

b) Will mining activities and watershed disturbance alter the quantity and spatial/temporal patterns of nutrient loading, and thus alter lake and stream productivity?

c) Is the baseline data of sufficient precision and comparative value to determine the impact of subsequent mining activity and watershed recovery on nutrient loading and lake and stream productivity?

11) The Quinsam Coal Ltd. report to the Inquiry identifies phosphorus as the most likely nutrient limiting primary autotrophic and heterotrophic production in the lakes and streams. The nutrient data as presented in Norecol (1983 a) report indicates severe nitrogen limitation. Average total phosphorus concentrations in that report were 5.9 to 6.8 ug.L^{-1}, which are mesotrophic levels. These levels of phosphorus are 2 to 4 times higher than the productivity levels (chlorophyll) would indicate. Thus, either the lakes are severely nitrogen depleted with some intrinsic characteristic that inhibits the growth of nitrogen-fixing netplankton, or the phosphorus and inorganic nitrogen data as presented are inaccurate.

From sampling done by the Department of Fisheries and Oceans, it was found that measurable levels of inorganic nitrogen in the epilimnion and total phosphorus concentrations were consistent with the levels of productivity indicated by chlorophyll measurements (Quinsam Coal Ltd. report to the Inquiry).

Apparently, the phosphorus and inorganic nitrogen data as reported by Norecol do not reflect the current nutrient levels in Middle Quinsam and Long Lakes.

The conclusion that phosphorus is the primary nutrient limiting lake productivity is probably valid and is consistent with DFO's extensive (7 years) limnological data base on coastal B.C. and Vancouver Island lakes. However, the existing baseline data on current nutrient levels in Middle Quinsam and Long Lakes are very contradictory and of dubious value as a modelling database or as a comparative database to assess the impact of mining on nutrient levels in the lakes and streams of the Quinsam drainage.

12) Doubts were cast on the modeling predictions on the following basis:

The Norecol (1982) and Quinsam Coal Ltd. (1983 d) reports use two different nutrient models (Qual II and MINICLEANER) to conclude that the high nitrogen loading from mining activities will not significantly alter the productivity of the lakes and streams in the Quinsam drainage system. This is based on the assumption that mining activities will only change the levels of inorganic nitrogen loading to the lake. In their 1982 report Norecol utilized nitrogen loss rates of 1% and 6% from ANFO and slurry explosives, respectively. In the QCL (1983 d) report to this Inquiry, a 3% loss rate for slurry explosives was also used for the purposes of modelling the impacts of nitrogen loads on the Quinsam system. According to the models, these nitrogen loss rates are expected to significantly elevate nitrogen levels in the Quinsam system over existing background levels. Mining impacts on phosphorus loading were assumed to be negligible. Coupled with the previous conclusion that phosphorus is the primary nutrient limiting lake productivity, it is not surprising that both models conclude that high nitrogen loadings from mining activities will have a negligible impact on the phosphorus levels and productivities of the lakes and streams. However, in the QCL(1983 d) report, no information on phosphate levels used in the model is provided. If the "moderately high" orthophosphate value of 0.02 mg/l used in the 1982 Norecol report was used in the recent modelling exercise (MINICLEANER), the conclusion that "...no appreciable changes in productivity will result...." is highly suspect. Further scrutiny of assumptions and values used as input variables to the recent model is necessary before assessments of its utility to predict impact can be made.

The prediction of phosphorus loading as a result of mining activities is critical to predicting lake and stream responses in the Quinsam system. The

Norecol (1982) report assumes that (p.37) - "Increased phosphorus levels as a result of mining activity are expected to be minimal because of uptake by sediments (Syers 1973) in settling ponds due to flocculation and the proposed method of sewage disposal to a drain field". The validity of the assumption that mining activities and subsequent watershed recovery will neither increase nor decrease the current low levels of phosphorus loading, nor substantially alter the temporal or spatial patterns of loading, must be critically examined before mining impacts can be predicted. There are presently insufficient scientific data to support this assumption.

Since we know that dissolved nitrogen loads will increase in the Quinsam lakes and streams as a result of mining, what we must know before potential impacts of the QCL development on water quality can be assessed is the current baseline level of phosphorus loads and concentrations to the system, and a sensible, scientifically-based prediction of proposed changes of phosphorus loads and concentrations in surface waters throughout the duration of the project.

13) The QCL (1983 d) report to the Inquiry made no reference to the potential impacts of nutrient loads on the Quinsam River downstream of Middle Quinsam Lake other than the general statement (page 46) that "...increases in nitrogen in the upper Quinsam River system are not expected to have any measurable impact on salmonid fish populations ....downstream of Middle Quinsam Lake". This conclusion is not supported by any detailed data or discussion in the QCL report. Thus, the concerns regarding nutrient related impacts in the Quinsam River as expressed in the 1982 DOE/DFO Task Force Report have not been resolved and will require further consideration.

14) In the 1982 Quinsam Coal Task Force Report (DOE/DFO 1982) the following recommendation was offered:

> "A detailed examination of the proposed nitrogen reducing techniques (macrophyte uptake and irrigation/fertilization) should be conducted to determine their feasibility and acceptability as nitrogen control strategies".

Information regarding nitrogen control techniques has still not been provided, although QCL (1983 a) stated that the area is "under consideration".

15) Acid generation is the root cause of probably the most serious effect coal mining can have on aquatic systems. Some of the waste rock in the strata proposed to be mined by Quinsam Coal and the reject material from the coal preparation plant have been identified as potential acid generators. The proper handling of this material to ensure that "acid mine water" is not discharged to the Quinsam River system must be achieved.

Given the low alkalinity (acid buffering capacity) of the Quinsam River, the discharge of low pH (acid) waters could have serious effects on receiving water quality and fisheries resources in the system. Generally, waters for supporting salmonids should be maintained within a pH range of 6.5 to 8.5, although the presence of toxic substances (eg. metals) which are affected by pH may result in more restrictive criteria (Sigma Resource Consultants, 1979). Consequences of a reduction in the pH of receiving waters caused by the discharge of acid waters could include: elimination of sensitive species and proliferation of tolerant species, direct acute effects, reduction in density, biomass, and diversity of aquatic organisms and reduction in reproductive capacity in adults and in viability of eggs and alevins (Martin and Platts,1981).

16) A review of the investigations and proceedings leading up to the present mine plan and the recommendations of the Sturm report was presented. The Company's mine plan and the proposed additions suggested in the Sturm report are as follows:

a) placing potentially acid generating materials in the backfills near the bottom of pits except for the two out of pit waste rock dumps;

b) surrounding the acidic materials with calcareous overburden;

c) early covering of the pits with till and establishment of a vegetative cover;

d) flooding of acid generating materials in the post mining situation.

The plan proposed in the Sturm report includes the elements of the Company's plan as well as:

a) encapsulating preparation plant rejects in a compacted calcareous envelope in the backfilled pits unless those rejects are submerged at all times;

b) placing potentially acid generating materials either completely above or below the water table;

c) blending or mixing of potentially acid generating materials such as riders, roofs, or seam cleanings (pit rejects) with thick calcareous zones and deep burial near the bottom of the pits;

d) encapsulating potentially acid generating materials in the out of pit dumps;

e) spreading of calcareous materials on the surface of the final backfills.

17) The Federal Agencies point out that as far as risk is concerned, an assessment of the probability for the formation of acid mine drainage at Quinsam Coal's site has been done by two qualified experts. Mr. Sobek in his evidence on behalf of the Company concludes (Quinsam Coal Ltd. 1983 b):

> "No AMD (Acid Mine Drainage) problems will occur provided that Quinsam implements their management practices as outlined in the Stage II Addendum and Mr. Milner's presentation".

Sturm Environmental Services in their report to the Ministry of Environment states (Sturm Environmental Services, 1983):

> "Calculations show that, excluding preparation plant refuse, the amount of neutralizing

> materials versus potential acid-generating materials is as great as 15:1 in some areas and may be as low as 8:1 in others. These ratios are high enough to preclude acid generation, if proper material management techniques are incorporated.
>
> "Preparation plant refuse that is to be returned and buried back into the active pits comprises approximately 2% of the volume of the backfill. Even though this material demonstrates a potential for acid-generation, there are sufficient neutralizing agents that can be manipulated in order to incorporate burial techniques that will not generate acid".

The Federal Agengies also noted that, while both experts conclude that acid mine drainage would not be generated, the experts do indicate that this is predicated on the implementation of certain material management practices.

18) The Federal Agencies seemed to indicate that the Company's mine plan could be successfully implemented, provided the plan included a thorough understanding and commitment to each element of the plan, dedication from the president to the pit workers in satisfying their obligations, and continuous attention to details which may necessitate modification to the plan. The regulatory agencies must also be committed to independent enforcement and surveillance.

19) The Federal Agencies said that in view of the sensitivity of the receiving environment to discharges of acid mine drainage, and given the uncertainties present in the prediction of acid generation potential and the effectiveness of management practices, it is necessary that a contingency plan be developed and in place prior to the start of mining. The plan should address the steps to be taken if acid mine drainage were found in pit water, raw coal stockpile runoff, or thickener sludge leachates in order to prevent the release of acid mine drainage to the receiving environment.

20) The Federal Agencies noted that the Sturm Environmental Services' report contained recommendations for contingency plans, including:

a) installation of monitoring wells in each of the pit areas;

b) use of a chemical pretreatment pond for contaminated pit water;

c) an alternative site selected and planned for the burial of plant rejects.

The Federal Agencies also pointed out, however, that the diversion of treated acid mine drainage to the settling ponds may affect the ability of those facilities to meet the specified suspended solids limits and their possible use as nutrient control facilities. Large volumes of gelatenous, low-density sludge can be generated in acid mine drainage treatment systems and this sludge could very quickly fill a settling pond not designed to accommodate them. A contingency plan should specify both neutralizer addition and sludge sedimentation facilities in the pits or other separate treatment systems. The mine site sediment settling ponds should not be used for acid mine water treatment unless special provisions are made.

Pit sumps and visible seeps must also be monitored in order to provide an early warning of changes in the backfill water quality. The contingency plan might also include the use of acid mine drainage control techniques such as bactericides (surfactants), surface sealants (plastic liners or clays), or special intensive lime applications.

21) The Federal Agencies noted that the results of the column leach tests currently underway were not known.

22) Effluents from coal mining operations may, under certain conditions, contain elevated levels of heavy metals. These elevated levels arise from the dissolution or direct oxidation of metal containing minerals in the rock.

Dissolved heavy metals in waters polluted by mine drainage are toxic to aquatic biota; however, actual toxic effects are dependant on a number of factors such as the fish species, age and stage of development, water temperature, pH, dissolved oxygen concentrations, total hardness, and interactions with other pollutants. In general, acute fish mortality results from exposure to high metal concentrations, but continuous exposure to low dissolved metal concentrations can result in chronic effects, such as behavioural changes and reproductive failure. Both ultimately affect species productivity. Heavy metal releases into surface waters could be particularly critical in the case of the Quinsam Coal mine, given the sensitive nature of the receiving waters. Baseline receiving water monitoring indicates that natural metal levels are very low and the water has low pH buffering capacity (ie. low alkalinity and low hardness). In addition, transplanted coho fry being "naive" hatchery fish (those not previously exposed to heavy metals) may be more sensitive to small increases in metal levels than non-naive fish (Chapman 1978; Lorz and McPherson 1977; Alderdice and McLean 1982).

23) B.C. Research for Ker Priestman and Associates Ltd (July 1979) notes that acid leachates from coal seams and some waste materials were high in certain dissolved heavy metals, eg. cobalt, copper, iron, manganese, nickel, chromium and zinc, under low pH conditions.

The EPS data report by Sneddon and Kelso (1983) showed high levels of arsenic, copper and iron in sediments of Middle Quinsam Lake and Long Lake. In the event that acid generation did arise from the operation of Quinsam Coal, there is a concern that these metals may be released from the sediments. Such release would further degrade the receiving environment.

The Stage II Addendum included results of some limited metal analyses of waste rock samples. These data showed relatively high total metal concentrations of some elements, particularly iron, although levels of copper, lead and zinc were also relatively high. Fish toxicity tests (96-hour, LC50 bioassays) were conducted on the seven composite samples upon which acid generation tests were also conducted. As none of these samples indicated a positive acid generation potential, it is not surprising that the leachates from these waste rock materials were also non-toxic to fish.

Since no metal analyses were performed on the bioassay test solutions, there is no indication of the quantity of metals that may be released under non-acid conditions. The results of the column leaching tests currently underway may provide some important data in this regard.

24) The formation of AMD would result in the development of heavy metal concentrations for which control, although technically possible, may be expensive. Under non-acid conditions, metal levels could be elevated but these levels would be of less concern than those generated under acid conditions. It is difficult to predict the levels likely to occur in the effluent. Accordingly, mitigation techniques and contingency plans for control of metals should be available before the mine goes into operation.

25) The general approach taken by the Company in developing its data collection program is satisfactory, but a number of items are still outstanding, which are as follows:

  a) Water quality or biological monitoring of No-Name Lake.

  b) Water quality sampling on the Quinsam River downstream from Middle Quinsam Lake should be located further down the river from the site presently selected.

  c) Additional macroinvertebrate sample sites should be located on No-Name Lake, and in Long Lake at the discharge points of the proposed settling ponds No. 2 and No. 3.

  d) The Company has not yet reported the identification and enumeration results of its macroinvertebrate study in the Quinsam River at Argonaut Road Bridge, Middle Quinsam Lake Outlet, Middle Quinsam Lake and Gooseneck Lake.

26) The hydrometric program outlined by the Company monitoring program is generally acceptable; however, arrangements regarding the co-operative data collection program need to be clarified.

27) Suspended solids monitoring by the Company is generally adequate; however, additional detailed baseline data should be collected immediately downstream of the project area on the Quinsam River.

28) In relationship to future monitoring, consideration must be given to the frequency of sampling.

Some additional data collection by Federal and Provincial Agencies can be expected. The monitoring program should retain enough flexibility to be able to respond to progress of the project or unexpected environmental changes. A program that is initially relatively intensive but which can be moderated as the results demonstrate the success of mitigation measures is required.

29) It is recommended that the Company be required to prepare and publish a comprehensive environmental data report for each calendar year. This should be due on 1st March each year. Government Agencies should be prepared to follow a similar procedure. The data should form the basis for an interpretative report to be prepared by an independent environmental consultant commissioned by the Company. The interpretive report should be made available to the interested public.

30) Our Departments have reviewed the draft guidelines for the Quinsam Coal Surveillance and Supervision Program prepared by the Ministry of Environment. We endorse that approach. Should the mine proceed, our Departments would supply additional occasional surveillance as an audit of the effectiveness of the programs mounted by the Province and the Company in protecting Federally-managed resources. The audit would comprise water quality and biological sampling similar to that reported in our data report by Sneddon and Kelso (1983), tabled at this Inquiry. There would also be visits by Federal Fishery officers and regular inspections and operations by the Quinsam Hatchery staff as part of their program.

31) Further comments on monitoring were as follows:

a) The Company's detection limits for nitrate and ammonia are 0.005 mg/l and 0.01 mg/l, respectively. These do not meet the detection limits recommended for nitrate (0.001 mg/l) nor ammonia (0.004 mg/l).

b) Zooplankton were not sampled from No Name Lake, but were taken from Middle Quinsam Lake, Long Lake, Gooseneck Lake and Lower

Quinsam Lake. Quinsam Coal Ltd. chose to use a #10 mesh (150 micron aperture) plankton net as opposed to the #20 mesh (80 micron aperture) net. A 1975 study of plankton in Kamloops Lake showed that the #10 mesh net did not retain the majority of the Rotifers, thus indicating that #20 mesh is more accurate in zooplankton capture.

c) The Company has reported heavy metal concentrations in zooplankton sampled; however, they have yet to report ash-free dry weight, identification and enumeration data.

d) Water quality monitoring of Upper Quinsam Lake may not be necessary as an extensive study was done by the Waste Management Branch in 1981 (see Equis Data Bank microfiche).

e) Periphyton and phytoplankton have not been sampled from No Name Lake.

f) An assessment of the water quality of the stream which enters the west-side of Middle Quinsam Lake should be conducted, assuming that the stream supports fish at certain times of the year.

g) A rain gauge should be installed at the mine site as soon as possible to gather baseline data. Furthermore, a rain gauge is required to determine the occasions for intensive suspended solids monitoring.

32) If the mine is to be permitted, bonding under the Mines Act should provide for the following:

- recontouring of all out of pit rock dumps;
- recontouring of inpit rock fills that have reached design elevations;
- reclamation of all recontoured areas;
- stabilization and revegetation of all cut banks, fills and other exposed ground associated with roads, water control structures, etc.

Since the Mines Act bond is based on area disturbed, it is essential to include in the calculation, all areas disturbed by the Company including roads, hydro rights-of-way, plant site and camp, water control structures as well as the total area of the pits and surrounding cleared areas.

33) Bonding under the Waste Management Act should provide for:

- the operation and maintenance of water treatment systems such as flocculation equipment at the sedimentation ponds, for a period of at least two years.
- monitoring of seeps both in pit and from any out of pit waste disposal areas for detection of initiation of acid mine drainage, for a period of two years.
- clean-up and safe disposal of the normal working volume of inpit rejects, preparation plant rejects and any other wastes with a potential for acid generation.
- continuation of the environmental monitoring program including preparation of reports, for a period including two complete calendar years.
- maintenance of the acid generation contingency plan including stocks of equipment and supplies, and readiness to deal with incipient acid drainage problems.

The Waste Management Act provides, under Section 8(b) that a manager may, in a permit, "require the permittee to give security in the amount and form and subject to conditions the manager specifies".

The Commission should recommend a form of security which can provide rapid access to the financial resources to maintain environmental protection in circumstances such as a labour dispute or unanticipated shutdown of the mine. It is preferable in, our view, to have the Company carry out the necessary environmental protection measures at all times. However, failure on the part of the Company to maintain or operate agreed protection measures, or to comply with an order to effect remedial measures, should rapidly lead to the invoking of the security.

34) The construction and operation of the barge loading facility at Middle Bay should not affect fish, fish habitat or migratory birds. The potential area affected is small and sensitivity is assessed as low to moderate.

THE PROVINCIAL MINISTRIES' PRESENTATIONS

1. Ministry of Energy, Mines and Petroleum Resources

SUMMARY OF THE PROVINCIAL GOVERNMENT'S PRESENTATION

A. MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES

The representatives of this Ministry gave the following testimony to the Commission:

1) The Ministry of Energy, Mines and Petroleum Resources, is responsible for the orderly development of Provincial mineral, coal, petroleum, natural gas and energy resources. It is made up of four divisions, as follows: Energy Resources Division, Mineral Resources Division, Petroleum Resources Division, and Administration Division. The Mineral Resources Division is subdivided into the following Branches:

   - Geological Branch
   - Inspection and Engineering Branch
   - Mineral Policy and Evaluation Branch
   - Mineral Titles Branch

2) The Inspection and Engineering Branch, which is particularly interested in this public inquiry, is responsible for the establishment and enforcement of Provincial legislation for the safety and health of workers in the mining industry, for reclamation and conservation of land, and also for ensuring that mining operations do not endanger the safety of the public.

3) The Branch is under the direction of the Chief Inspector of Mines, who has 12 District Inspectors (all of whom are required to have professional engineering qualifications), and additional support staff, including professional engineers, certified engineering technologists, an audiologist and professional agrologist. Also included in this staff are specialists to deal with all the requirements of mine operations, such as mechanical, electrical, dust, radiation, light standards, noise, vegetation and other related reclamation problems.

4) In addition to the District Inspectors, the Branch also has other inspectors with specialized knowledge, as follows:

   a) Environmental Control Inspectors - who are concerned with the working environment and medical surveillance of the labour force at mines.

   b) Reclamation Inspectors - who are responsible for ensuring that mine operators carry out the proper reclamation requirements of the Provincial legislation.

   c) Senior Geotechnical Inspector - who is involved in the civil engineering specialities of soil mechanics and rock mechanics, particularly in respect of waste dumps, tailings and settling pond impoundments.

   d) Mechanical Inspector - who provides advice of a specialized nature on all types of mechanical equipment with regards to the safety aspects.

   e) Electrical Inspector - who provides advice of a specialized nature on all matters pertaining to the safe use of electricity at mines.

   f) Senior Inspector of Mines (Coal) who is a specialist responsible for examining coal mining proposals to ensure satisfactory operations from the safety point of view, and to ensure maximum feasible recovery of the resource.

5) Should specialized problems arise at a mine, which are beyond the expertise of the staff of the Inspection and Engineering Branch, the Branch has the authority to seek outside independent engineering advice in respect of health and safety problems.

6) Apart from any specific requirements of the Mines Act, an Inspector has the right to order that certain remedies be applied, or such provisions be made at a particular mine to ensure the safeguarding of those employed in or about the mine, or the public.

7) It is a requirement that an Inspector shall visit every mine within his jurisdiction as often as his duties permit, or circumstances require.

8) The principal legislative documents within the Ministry which apply to the Quinsam Coal Project, are as follows:

   a) The Coal Act - which sets out who, in British Columbia, may receive and hold title to coal land. For the purpose of this Act, coal land is defined as land in which the coal or the right to explore for, develop and produce coal, is vested in or reserved to the Crown.

   b) The Mines Act and Coal Mines Regulation- which are the primary tools the Ministry has for regulating the health and safety of workers associated with coal mining in British Columbia, and for protecting the environment and the public from hazards associated with coal mining. The primary function of this legislation is to safeguard the mine worker and the public.

9) With respect to the Quinsam Project, the tenure for the coal is held within the area to be mined, either under licence from the Crown or in freehold. The freehold coal rights are owned by Weldwood of Canada Ltd. It is also understood that most of the surface rights for the site are held as a Tree Farm by B.C. Forest Products Ltd. The remaining small portion is held by the Crown.

The presently proposed pits are contained within the following Freehold and Coal Licence areas:

Pit 1 S - within the boundaries of Coal Licence #3670.

Pit 2 & 3S - within the boundaries of Coal Licence #3670 and #6874, and Freehold Block # 149 (a)

Pit 4 S - within the boundaries of Coal Licence # 6874 and Freehold Block #98, #149(a) and # 149(b).

Pit 5 & 6 S - within the boundaries of Freehold Block #98, #120(a) and #149(b).

Pit 2 N - almost completely within the boundaries of Freehold Block #120(a). A small portion near the northern tip lies just within Freehold Block #148 and Coal Licence # 7538.

Pit 3 N - almost completely within the boundaries of Freehold Block #26, with some small portions overlapping into Freehold Blocks #148 and #120.

10) The rights a Company has under a coal licence are contained in Section 12 of the Coal Act, namely;

(1) Subject to subsection (3), a licensee, under this Act and his licence, may explore for and develop coal on the location of his licence and may mine and remove those quantities of coal he may reasonably require for testing.

(2) A licensee is entitled to explore for and develop only that coal that is inside the boundaries, continued vertically downward, of his licence location.

(3) Subject to subsection (4), no licensee under his licence shall acquire any right, title or interest in the surface area of the location of his licence.

(4) Where the surface area of a licence location is owned by the Crown and is used or occupied only by the licensee, the licensee is entitled to enter, occupy and use, under this Act and his licence, the surface area to explore for and develop coal and, subject to the issue of a free use permit under the Forest Act, is entitled to use and remove timber situated on the location at the time he applies for the free use permit.

11) Before coal can be produced from any Coal Licence, it is necessary for a company to obtain a lease issued by the Minister under Section 24 of the Coal Act. The rights under a lease are contained in Section 22 of that Act, namely:

(1) Subject to subsection (2), a lessee may, under this Act and his lease, explore for, develop and produce coal on the location of his lease.

(2) Subject to subsection (3), no lessee shall acquire, under his lease, any right, title or interest in the surface area of the location of his lease.

(3) Where the surface area of a lease location is owned by the Crown and is used or occupied only by the lessee, the lessee is entitled to enter, occupy and use, under this Act and his lease, the surface area to produce coal and, for that purpose, is entitled to a licence under the Forest Act to cut timber situated on the location.

12) Before opening or beginning to open or develop a mine, the owner must file with the Chief Inspector a report and plan of the operations suitable to the Chief Inspector, and the plan shall include the following:

(a) to take into consideration the safety of the public and persons involved in the work;

(b) be designed so as to make it as practicable as possible in the future to mine other zones affected by the plan; and

(c) in relation to a coal mine, to provide for maximum possible recovery of the resources having regard to sound engineering practice.

13) The Company has submitted a draft plan of their mining operations to the Inspection and Engineering Branch of the Ministry. This plan does not deal with the whole of the mine, but does describe the

operations in general terms. The Branch has found that the preliminary geotechnical studies do not suggest that there will be any problems at the proposed pond and dump sites; therefore, providing the yet-to-be-specified engineering details are correctly observed during construction, the Inspection and Engineering Branch of the Ministry is satisfied that the ponds and dumps can be safely established at the selected sites.

The final plan of the system under which it is proposed to work the mine, together with geotechnical reports and engineering details, will be carefully reviewed upon submission by the Company. The Chief Inspector of Mines and members of his staff will have to be satisfied that the dumps, pond embankments, and roads will remain in stable condition during construction, throughout the life of the mine and, where still in existence, are also stable after abandonment of the mine.

14) The Branch is confident that there will be no need for any major modifications with regard to the position of the buildings, the open pits, the dumps, the settling ponds or the roads. The Branch is also satisfied that the mining of coal can be carried out by open pits in the manner described by the Company in their Stage II Reports and plans so far reviewed.

15) Reclamation of land disturbed by mining is administered by the Ministry of Energy, Mines and Petroleum Resources, Inspection and Engineering Branch, Reclamation Section, under sections 7, 8, 9, 11 and 30, and the Regulations pursuant to the Mines Act.

16) The Company is required to file with the Minister a program for the protection and reclamation of the surface of the land and watercourses affected by the mine in a form and containing the information the Minister may require before commencing preparatory work for production from the mine, and the program must include the particulars and maps that may be prescribed.

The following information, particulars and maps are required to be included in the protection and reclamation program, when submitted to the Minister:

(a) a map showing the location and extent of the mine, and the location of lakes, streams and inhabited places in the vicinity;

(b) particulars of the nature of the mine and the extent of the area to be occupied during the probable duration of the mining operation;

(c) particulars of the nature and present uses of the land to be used;

(d) a program for reclamation and conservation of the land during, and on the discontinuance or abandonment of, the mining operation, with particular reference to

  (i) the location of the land;

  (ii) the effect of the program on livestock or wildlife, watercourses, farms, inhabited places in the vicinity of the mine and the appearance of the site of the mine; and

  (iii) the potential use of the land, having regard to its best and fullest use, and its importance for existing and future timber, grazing, water, recreation, wildlife or mineral use.

17) Section 7 of the Mines Act requires that a notice of filing of the program of reclamation be published, and provides that any person affected by or interested in the program may make representation to the Minister within 30 days. The program, therefore, is a public document.

18) Section 8 of the Mines Act (Reclamation Advisory Committee) formally establishes this Committee - current membership includes representation from the Ministries of Agriculture and Food; Forests; Environment (Fish and Wildlife Branch, Water Management Branch, Waste Management Branch); and Lands, Parks and Housing. It is chaired by the Chief

Inspector of Mines. The Reclamation Advisory Committee reviews submitted programs and makes recommendations to the Minister of Energy, Mines and Petroleum Resources. A time limit of 60 days after advertising of the program is set within which the Minister must approve, reject or amend the program. If approval is given, the Minister must issue a permit authorizing the work.

19) Section 9 of the Mines Act (Security) outlines the requirement for, and procedures to be followed, in posting the security deposit (reclamation bond). On-going reclamation is required, and if this is not done, the bonding may, if required by the Minister, be increased. The initial security deposit cannot exceed $2500/ha of area to be used for the mine and the waste disposal of the mine.

Factors which are taken into account in the initial establishment of bonding are:

(a) the amount of land disturbed;

(b) the degree of difficulty in reclamation;

(c) the type of land disturbed;

(d) environmental consideration;

(e) past performance of the Company

20) Quinsam Coal Ltd. submitted a reclamation plan to the Chief Inspector of Mines, in compliance with Section 7 of the Mines Act on September 26th, 1983. The site factors which determine the feasibility and success of coal mine reclamation are generally favourable at the Quinsam site. These include: topographic relief, soil type, and climate.

In comparison to other B.C. coal mines,(e.g. the Kootenays, the Peace River area, and the Interior) the terrain is relatively flat, thus eliminating the possibility of developing long, difficult-to-reclaim slopes. The existence of big cutfaces (headwalls) is also minimized.

The plan to cap overburden dumps with one meter of glacial till, and an additional 0.5 meters of topsoil - both excellent and available growth media - will ensure viability of future vegetation.

The climate of the East Coast of Vancouver Island is well known for being conducive to plant growth.

The plan of mining and reclamation proposed by Quinsam Coal Ltd. has allowed advantage to be taken of the favourable site factors. Firstly, it has been noted that the removal and dumping of overburden is confined largely to the pit area itself. Only 10% of the waste rock will be placed in out-of-pit dump areas. Secondly, mining and reclamation is proposed to progress in a sequential manner across the pits, with only approximately 100 of the maximum 600 hectares of disturbance open at any given time. Thirdly, spoil slopes are proposed to be recontoured to a maximum of 2 horizontal to 1 vertical, with 6 m benches at every 20 m vertical lift which will be used for hydroseeding and vegetation operations.

The reclamation plan lists four objectives:

(1) To return the land surface to a shape which is compatible with the projected future uses of the area. To this end, seven landscape units have been identified and climax vegetation specified.

(2) To ensure that erosion is minimized by revegetation of exposed erodible materials. In support of this revegetation, treatments have been designed and species selected.

(3) To provide reclaimed lands which are productive ecosystems.

(4) To ensure that the reclaimed lands are self-sustaining.

Items (3) and (4) are totally inter-related, and the success to be achieved here, although significantly affected by the site factors and mining and reclamation methods, will, in part, be determined by the monitoring and inspection programs of regulatory agencies.

A significant point in the reclamation exercise is the placing of the till cap on exposed pit and dump materials. The capping has two beneficial effects: it tends to seal the exposed mass from water passage, and also from air, reducing two of the several essentials for the generation of acid drainage.

The Quinsam Reclamation Plan has been reviewed by the Reclamation Section, and is considered to be acceptable for review by the Reclamation Advisory Committee.

During this hearing, it has been indicated that the acid generating material could be disposed of safely by placing it within the "in pit" waste dumps, anywhere between the footwall and 20 to 30 ft. (6.1 m to 9.14m) from the top of the dump. Therefore, it would appear that the problem of acid drainage will not be as acute as was originally envisaged by certain groups. The Inspection and Engineering Branch believe that the Chief Inspector has on his staff sufficient qualified and competent persons to ensure that satisfactory standards are maintained within the mine, as defined by the Mines Act. This would include suitable surveillance of any standards laid down for the control of acid generation within the mine.

THE PROVINCIAL MINISTRIES' PRESENTATIONS

2. Ministry of Environment

B. MINISTRY OF ENVIRONMENT

The representatives of the Ministry of Environment gave the following testimony to the Commission:

1. The purpose of the Ministry's staff appearing at the Inquiry Commission was to convey the existing information on the project relating to:

    a) the history of environmental review of the project through the Guidelines for Coal Development,

    b) the current status of important environmental issues arising from that review, and

    c) progress made towards the development of a project design acceptable to the Ministry of Environment.

2. The scope of the testimony was limited to the Ministry of Environment's legislative mandate as set out in the Ministry of Environment Act. The aspects of this mandate relevant to the Quinsam Project are as follows:

    a) to encourage and maintain an optimum quality environment through specific objectives for the management and protection of land, water, air and living resources of the Province;

    b) to manage, protect and conserve all water, land, air, plant life and animal life, having regard to the economic and social benefits they may confer on the Province.

    c) to monitor environmental conditions of specific developments and to assess and report to the Minister on general environmental conditions in the Province.

3) The Environment Management Act enables the Ministry to manage the environment in this regard by:

   a) planning, research and investigation with respect to the environment;

   b) developing policies for the management, protection and use of the environment; and

   c) providing information to the public with respect to the quality and use of the environment.

4) The environmental objectives of the Ministry for the Quinsam River Watershed, both for the present and the future, are as follows:

   a) maintenance of water quality suitable for fisheries;

   b) protection of water for future domestic use; and

   c) maintenance of an environment aesthetically desirable for recreational use.

5) Sections 4 and 5 of the Environment Management Act give the Minister power to issue environmental protection orders and implement environmental emergency measures respectively should the operation of the mine have or potentially have a detrimental impact on the environment. If an emergency is declared, under Section 6 of the Act, the Minister may pay for the necessary protection measures with Government funds and subsequently seek to recoup these monies from the Company through the Courts.

6) The Federal Hatchery on the Quinsam River is planning an expansion of its existing facilities to augment current fish production. The present production of fish is currently about 127,200 salmonids annual harvest, including about 10,000 from the mine site area. This harvest is distributed amongst the major species as follows:

Coho	40%
Pink	38%
Chinook	13%
Chum/Steelhead	1%

Chinook and coho production in the Quinsam system currently supports an estimated 58,130 angler-days per year to the Gulf of Georgia sport fishery.

The Quinsam River has one of the highest steelhead production capabilities per unit of stream area on Vancouver Island, producing the majority of the Campbell River system steelhead stock. Angling effort on the Quinsam River for steelhead ranks third on Vancouver Island and is among the top ten in the Province (B.C. Fish & Wildlife Branch). Steelhead production in the Quinsam River supports over 5,000 angling days annually in the Quinsam and Campbell watersheds. There is also angling for coho salmon.

Angling activity also takes place on Upper, Middle, and Lower Quinsam Lakes for resident trout populations. The most recent creel survey, conducted by regional Ministry staff in 1980, estimated angling effort activity to be 6,900 angling-days per year.

There is also a potential for substantially increasing system production through various enhancement measures such as hatchery expansion and habitat improvements.

Other benefits attributable to the Quinsam fishery include:

a) the educational and recreational values associated with public viewing of spawning salmon;

b) revenue to the local economy from tourism and recreation; and

c) an opportunity to increase headwater fish stocking in conjunction with the Quinsam hatchery.

7) From a historical point of view, the project was reviewed as follows:

Following review of Stage II reports early in 1981, the Ministry noted several information deficiencies in the documents provided. Based on recommendations from this and other Ministries, the Environment and

Land Use Committee (ELUC) withheld approval-in-principle and required that Quinsam Coal conduct studies on:

a) the hydrogeology of the mine site area with reference to the potential for acid generation, and related impacts on the fish resources of the Quinsam Watershed; and

b) the impacts of coal transportation including both the truck haul route and barge port facilities.

The Company submitted an addendum to the Stage II report in August, 1982, reporting the results of the additional studies and providing new information on project plans. Based on recommendations from this and other Ministries, ELUC granted approval-in-principle to the project on Febraury 23, 1983, subject to the following conditions with respect to environmental management:

a) development and implementation of a mutually acceptable environmental surveillance and supervision program;

b) development of detailed mine plans for ensuring that appropriate mixtures of acid-generating and acid-consuming materials are available to preclude the net production of acid, both in waste rock piles and reclaimed pits;

c) establishment of an acceptable baseline, construction and operational monitoring program;

d) maintenance of suspended solid levels below 25m/L, in both settling pond and diversion discharges during mine operation, and in discharges from all sources during construction; and

e) assessment of phosphorus and nitrogen levels and algal growth in the Quinsam and Campbell River system, and effective management of any future eutrophication problems which may arise.

Further, the ELUC noted:

a) that the Company has already made written commitment to the Coal Guidelines Steering Committee to fulfill these requirements; and

b) that substantial bonding would be required for the project, the details of which were to be finalized at Stage III.

8) The final condition of the ELUC approval-in-principle was that a public inquiry would be held under the provisions of the Environment Management Act prior to the issuance of any of the necessary permits and licences required for project development. The letter from the ELUC to Quinsam Coal Ltd. also noted that reclamation aspects of project design are considered to be of crucial importance, and that during Stage III the final details of the reclamation plan will be reviewed by the Environment and Land Use Technical Committee before permits are issued.

9) The Ministry has committed staff resources to establish ambient water quality objectives for the Quinsam watershed. These objectives will be established to protect the use of water for fish, fishing, recreation aesthetics and the possibility of using the water for domestic purposes.

10) Certain geological materials to be mined at the Quinsam Coal Project have the potential for producing acid through the action of sulphur oxidizing bacteria on the sulphur present in those materials. Where these materials contain more acid-producing components than acid-consuming components (calcium carbonate equivalent), and adequate amounts of oxygen and water are present, the potential for net production of acid exists.

Since the total amount of waste and overburden material to be produced over the life of the Quinsam project contains about 10 times more acid-consuming material than acid-producing, it is theoretically possible to mix the materials so that any acid produced would be neutralized. However, the key to achieving the objective of "no net acid generation" lies in the development and implementation of a number of techniques for field surveillance, geochemical sampling, acid-base accounting, and materials handling.

Where such techniques are not applied, acid generation can arise from dispersed source-materials buried in mined-out pits, and can cause contamination of ground and surface waters. After-the-fact collection and treatment of acidified water can be costly and, often, ineffective in the long-term.

The potential for acid production was recognized early in the review of the various Stage II reports. To address this major concern, the Company was directed to carry out further studies in this regard and illustrate to the Hydrogeological Technical Review Committee how it would avoid or mitigate the possibility of acid mine drainage to the Quinsam River Watershed. This information, when submitted by the Company, was found to be generally satisfactory.

In addition to the Company's information, the Ministry also hired the services of Sturm Environmental Services, of West Virginia, to review all of the available information pertinent to the Quinsam Project and to prepare an evaluation of the acid generation potential and treatment methods for the project.

Sturm Environmental Services has considerable background and experience in mine spoil and overburden science in the Appalachian coal fields, and has worked on numerous evaluations concerning material handling in surface mining as it relates to burial of toxic and or potentially toxic disulfide pyritic materials. Available information on the Quinsam project, including Stage II reports, reviews and study proposals, were provided for the evaluation. A field inspection of the projected site was also undertaken by the consultants. (The main conclusions and recommendations of the Sturm Report follow the testimony of this Ministry).

The Ministry is broadly in agreement with the Sturm recommendations and believe they provide a good basis for preparing the mine and reclamation plans under the responsibility of the Ministry of Energy, Mines and Petroleum Resources, and for waste management permits. The Ministry would emphasize two points:

- Any potentially acid generating materials that will be disposed of above the water table should be sandwiched in compacted calcareous material and capped at the surface to make it impervious.

- Samples of the upper layer of Core Qu-82-05c have yet to be analysed by Mr. Sturm. This was the core which showed net acid generating potential in its upper horizon.

11) The objectives of the suspended solids control program are to maintain the existing water quality in the Quinsam River system for the protection of aquatic life, to minimize soil erosion so that soil productivity is maintained, and to sustain an aesthetically acceptable environment.

Research literature indicates that suspended solids loadings can reduce primary production, benthic invertebrate diversity and fish production. In addition, suspended solids can affect angling success and, therefore, the recreational value of the fishery.

A concern also exists that suspended solids may contain components which are toxic to fish.

In the Stage II Addendum report, the company outlined its plan with regard to the control of suspended solids. Applying the criteria commonly used throughout the mining industry, the Company calculated values of rainfall and storm run-off water parameters, and carried out settling experiments - all of which formed a basis for the preliminary design of water conveyance channels, treatment works, and other related hydraulic structures. This plan included the diversion of runoff water from undisturbed areas around the site to avoid having to treat an increased volume of contaminated water.

The maintenance of acceptable suspended solids levels in discharges from storm water ditches will require erosion control measures. Storm runoff water from coal preparation, storage and loading areas, and from mining pits would be treated with the help of flocculation agents in sedimentation ponds before being discharged into natural watercourses. In the case of unusually high storm activity, no water would be pumped from the mining pits, allowing them to flood, thereby reducing the load on the sedimentation ponds.

The Ministry recognizes the import of the Minister's directive regarding concentrations of suspended sediments. It also accepts the Company's commitment to discharge below 25 mg/L up to the one in ten year storm event, and below 30 mg/L up to the one in 200 storm event. However, there is a need for further discussions with the Company to refine engineering details associated with flocculent and settling tests as well as pond size. Generally, the Ministry feels confident that it can issue a waste management permit that will adequately protect the environment of receiving waters for these discharges.

12) The potential exists for relatively large increases in nitrogen in the Quinsam system due to the incomplete combustion of nitrogen-based explosives used in the mining operation. About 6,700,000 kg. of explosives would be used annually, containing between 20 and 33% nitrogen by weight. Studies at other mines have shown that between 1 and 6% of the nitrogen in explosives can reach surface water, depending on site-specific factors (e.g. relative amounts of wet and dry blasting, mine drainage treatment and spill control/housekeeping measures) (Pommen, 1983).

Quinsam Coal conservatively assumed that about 5% of the nitrogen in explosives would enter surface waters. The Ministry's estimate of nitrogen loss is about 2.5%, and there is potential to reduce this, using alternative blasting and effluent treatment techniques. The 5% loss assumed by Quinsam Coal resulted in predicted nitrate concentrations in the Quinsam River downstream from the mine of up to 6 or 7 mg/L under low flow conditions occurring once in 16 years. The present nitrate concentrations in the Quinsam River downstream from the mine range from 0.02 to 0.36 mg/L.

It is noteworthy that a limited amount of additional nutrients can increase fish productivity, depending on the nature of the nutrients, the ratio of their concentrations, and the magnitude of the increases in concentrations. It is therefore important to have an adequate understanding of the system in question to avoid problems, or to recognize opportunities for benefits.

The Ministry agrees with the Federal Department of Fisheries and Oceans that there will be a change in the water quality of the Quinsam lakes and river due to nutrient additions resulting from the mining operation. Based on available data, the lakes would likely become mesotrophic. The data supplied by the Company leave some doubt whether phosphorus or nitrogen is currently limiting algae growth. There is no doubt that once the mine is in operation, phosphorus will become the limiting factor.

The Ministry believes that some additional phosphorus will enter the surface waters as a result of the local mine operation, due to the removal of trees, soil disturbance and the disposal of sewage. At present, these amounts cannot be quantified;consequently, the risk of eutrophic conditions developing cannot be estimated.

The Ministry believes that this risk can be reduced if the Company recognizes that phosphorus loadings can result from its operations. Thus, it should commit itself to a detailed monitoring program during construction and be prepared to implement appropriate control measures to reduce these phosphorus loadings to acceptable levels.

The Ministry also supports the recommendations of the Federal Department of Fisheries and Oceans for further baseline monitoring of nutrient balance in the lakes and streams over the next six months minimum, and preferably a year. Such data will assist the Ministry to establish the appropriate ambient objectives for nutrients in the lakes and river, and enable both the Company and the Ministry to predict more accurately the risk of eutrophication.

Given that it will become necessary to control phosphorus loadings throughout the watershed to protect ambient water quality, the Ministry would recommend to the Commission that it consider mechanisms for enabling such controls to be implemented.

The Company has made a commitment to assess phosphorus and nitrogen levels and algal growth in the Quinsam River system, and to solve any future eutrophication problemsif they arise in relation to nutrient loadings from the mine.

13) In connection with air quality, the Ministry noted that the climate in the Quinsam Coal area can be described as Maritime West Coast, with moderate temperature and precipitation. The major industrial sources of air emissions include a Pulp Mill at Campbell River and wood-waste burners. Ambient air quality data collected in the Campbell River area show

that the levels are all generally within the most stringent Pollution Control Ambient Air Objectives. The existing air quality in the proximity of the proposed Quinsam Coal project area can be expected to be clean.

The major sources of emissions from the proposed project were identified as fugitive dust, which will be generated by the various mining activities, coal hauling and coal terminal operations. There is also the potential concern about soiling from fugitive coal dust.

The Company has developed plans to minimize source emissions with baghouse filters, and to control fugitive dust generation by using water sprays, covered trucks and covered conveyors, etc. The Company has also indicated that a baseline and on-going monitoring program will be conducted at the mine-site, haul route and the barge dock. The objective of the monitoring program is to identify the adverse effects of the coal dust on the receiving environment.

14) Bonding under the Waste Management Act is considered necessary in order to offer some protection against unexpected or unforeseen events which may have some potential for environmental impact. As part of its approach to risk minimization, therefore, the Ministry will require bonding which will be cash or a performance bond, or a combination of the two, as part of the waste management permitting process at Stage III. This bonding will be in addition to that required by the Ministry of Energy, Mines and Petroleum Resources as part of its reclamation permitting process.

The ELUC, in its Stage II approval-in-principle, stated that this Ministry would require substantial bonding for the Quinsam project, and that bonding details would be finalized as Stage III, prior to the commencement of project construction.

The facilities that would be subject to bonding under the Waste Management Act include:

- settling ponds
- disposal of preparation plant rejects, and
- emergency measures to control acid generation and discharges of nutrients.

The Ministry anticipates that the details of engineering design required to estimate costs of appropriate control facilities will be available before the Waste Management permits are issued.

15) Environmental monitoring refers to measurements of the quantity and/or quality of surface water, groundwater, biological species or communities (e.g. algae, benthos, fish, aquatic plants, etc.), sediment, air, liquid effluents and air emissions. Environmental monitoring is conducted during baseline, construction, operational, and, in some cases, post-operational phases of a project. Because the Project has the potential to affect very high-value aquatic resources, the Ministry placed a high priority on the establishment of a comprehensive monitoring program for all phases of the Project.

The objectives of the environmental monitoring program for the Quinsam Coal Project are -

(i) to detect changes in the environment and their causes so that appropriate action can be taken (remedial measures or changes in monitoring program);

(ii) to quantify the amount of any damages that may occur in order to calculate compensation;

(iii) to assess compliance with permit requirements;

(iv) to determine whether air and water quality objectives are being met (the Ministry intends to establish numerical air and water quality objectives for the Quinsam Coal Project).

The Ministry is generally satisfied with the environmental monitoring data and programs proposed by the Company, provided the additional baseline monitoring requirements recommended by the Federal Department of Fisheries and Oceans are included.

The Ministry would also support sampling fish populations in the channels into which discharges from settling ponds 1, 2 and 3, are proposed.

The environmental monitoring programs for all phases of the Quinsam Coal Project are subject to change, based on continuing review.

Further, a review of the acid generation report by Sturm Environmental Services confirms the need for operational and post-operational groundwater quality and level-fluctuation monitoring in conjunction with the disposal of materials which are potentially acid-generating. Details of this monitoring to be prescribed by this Ministry include:

- special purpose
- number and location of sample sites
- sampling frequency during baseline and subsequent phases of monitoring.

The Ministry proposes to set up an operational monitoring committee to establish the monitoring program required for various permits and licences. This committee would be chaired by the Waste Management Branch and include regional staff from the Ministry plus representatives from the Departments of Fisheries and Oceans, (Canada) and Environment (Canada), and the Provincial Ministry of Energy, Mines and Petroleum Resources. The committee would publish the results of its proposed program, which would be subject to the normal public review process prior to its finalization. During the operation of the mine, an environmental review committee should be established, reporting to the Regional Director of the Ministry of Environment in Nanaimo. This committee would review the results of the environmental monitoring program and publish these on a regular basis. From this Ministry's viewpoint, its regulatory requirements could be met through a membership consisting of regional staff and representatives from Department of Fisheries and Oceans, Environment Canada, Ministry of Energy, Mines and Petroleum Resources, and the Company. The Ministry is not opposed to the inclusion of non-government persons on this review committee, but leaves the recommendation of such membership to the Commission.

The main objective of the surveillance and supervision program is to ensure that the project is implemented through to its completion in compliance with prescribed environmental specifications. This program entails overseeing the planning, construction, operation and abandonment stages of this project.

The successful environmental management of a project depends upon:

- close liaison between government agencies and the proponent;
- full co-operation between construction and environmental supervisors;
- a Company commitment to the use of sound environmental practices;
- sufficient authority vested in the environmental officer to implement mitigative measures on site.

Since both surveillance and supervision entail overseeing a project, the terms are defined according to who is responsible for the task.

(a) Surveillance

Field inspection undertaken or sponsored by a government agency to ensure that the Company and its contractors are complying with the environmental terms and conditions applied to a project.

(b) Supervision

The continuous overseeing of a project by qualified staff (environmental supervisor) hired by the project proponent (or contractor) during the project implementation to help control environmental impacts in the field, and to ensure that the project is built according to environmental specifications.

The Company has made the commitment to develop and implement an environmental supervision program. It is expected that the Company's environmental supervisor will report any environmental problems to the Ministry's surveillance officer.

Surveillance of the project is the responsibility of government. As such, the Ministry will allocate one surveillance officer position for this project for a minimum duration of three years from the initiation of project construction.

The document tabled at the Inquiry outlining the terms of reference for the surveillance and supervision program is a proposal. Final terms of reference will be established following receipt of the Commission's report.

17) In accordance with the Waste Management Act, permits are required before the Company can discharge wastes to the environment. The key permits will involve plans to dispose of preparation plant rejects and effluent treatment to limit the discharge of materials such as nutrients, toxic substances and suspended solids, and may include disposal of acid-generating waste rock.

Permits are processed by the Ministry during Stage III of the Coal Guidelines review process, now underway. No permits will be granted until after the report of the Inquiry Commission has been received by the Minister of Environment.

Current Status

Applications have been submitted by the Company for the major discharges anticipated for this proposal, and these applications have been posted at the site, published and circulated to the Government Agencies. Company commitments are summarized in eight applications submitted to date. These applications include:

- two for air discharges: one for the proposed plant site, and the other for the barge loading facilities (Middle Bay).
- an application for refuse which deals with the disposal of plant rejects near the bottom of the pits; and
- five applications for effluent: three for settling pond discharges at the mine site, one for settling pond(s) associated with the truck wash at the load-out facility, and one for sewage discharge at the mine site.

The Ministry of Health is responsible for the discharge of domestic sewage at Middle Bay.

18) With reference to Stage III, the Quinsam Coal Company will require licences under the Water Act for all water used and approvals for changes in or about any stream. Water used for industrial, mining and domestic purposes will require a water licence. Work undertaken within the mine-site and infrastructure facilities for stream diversions, drainage, dewatering and storage for settling ponds will require several water licences and approvals.

Water licences will be required for any dam, diversion channels and culverts associated with water going to settling ponds. Any drainage structures not leading to settling ponds will require approvals under Section 7 of the Water Act.

To date, Quinsam Coal Ltd. has applied for a water licence to withdraw 7.1 litres per second from Gooseneck Lake in the Campbell River system.

Outstanding Issues:

The Company has not made application to date for the settling pond licences, nor for water approvals. The Company has proposed the use of recycled water from one settling pond for industrial water supply.

All the above mentioned works are not expected to have any measurable impact on the water quantity of the Quinsam River system. Nevertheless, the Company is required to install a continuous water level recorder at the outlet of Middle Quinsam Lake.

All hydraulic structures, including settling ponds, dams, spillways and diversion channels, will be designed to withstand the 200 year, 24-hour flood event. Additional settling ponds may be required on diversion ditches to restrict sediment discharges and these will be assessed on a site specific basis. Diversion facilities will require erosion control structures and stabilization by revegetation. Settling pond construction will be required prior to stripping and diversion.

No water licences or approvals will be granted until the Minister has received the report from the Commission.

The Ministry of Environment hired the services of Sturm Environmental Services of Bridgeport, West Virginia, U.S.A.,to make an evaluation of the acid-generating potential of the proposed mine. Mr. Sturm appeared before the Commission and gave testimony.

Mr. Sturm told the Commission that he had a Master's Degree in Science from the University of West Virginia. During the course of his career, he had worked for major coal companies in the United States on laboratory testing of soils and overburden in relationship to acid mine drainage, revegetation and reclamation. For a period of some 4 1/2 years, he had also worked for the West Virginia Surface Mining and Reclamation Association, which was a trade organization engaged in assisting mining companies to overcome acid mine drainage, revegetation and reclamation problems. In 1979, he formed his own consulting firm, backed by laboratory services, for the purpose of assisting mining companies to prepare mine plans and material handling programs, so that their operations would not produce environmental problems such as acid mine drainage, etc.

The main conclusions and recommendations from the Sturm report are as follows:

Conclusions:

1) Recognition and understanding of simple field clues is an essential prelude to efficient handling of overburden. Important field clues include: rock bedding, fractures, faults, colors (Munsell chips), streaks, mottles, textures, hardness (fine textures), strength or durability (sand or coarser textures), plant fossils, shell fossils, nodules, coal stringers, feel (rough, smooth,slick), smell, taste, crystal or cluster forms that identify mineral species, and fizz testing to detect and distinguish carbonates.

2) Evenly spaced columns of overburden samples for analysis must be sufficient to permit confident extrapolation of property measures across the projected mining pits. Coring and geophysical methods of estimating coal reserves can help guide decisions about spacing of overburden columns for analysis, but cannot eliminate the need for replicate sampling, especially in relatively new mining fields, or where geology is complex, or where limited data are inconclusive. Regardless of

intensity of advance sampling and analysis, it is helpful to examine carefully the overburden exposed during early stages of mining and to continue such examination plus selective sampling for analysis whenever uncertainties arise regarding acidic or basic potentials or related properties.

3) Ratios of calcium carbonate to sulfur provide a simple index of potential acidity, but a more complete and conclusive picture is provided when paste pH, present titratable acidity, and specific characteristics of the overburden materials are included as well.

4) When the paste pH of overburden or coal rejects is below 4.0, it is almost a certainty that sulfuric acidity is involved. Moreover, titratable acidity at such low pH values can be as great as -15 tons of calcium carbonate equivalent per 1,000 tons of material (that is as great as -1.5% $CaCO3$). It is well to remember, also, that exposed earthy materials at pH below 4.0 is likely to be naturally inoculated with sulfur oxidizing micro-organisms.

5) The major source of water to saturate each backfilled pit following mining will probably be precipitation on the site, since off-site surface flow will be diverted and in-flow capacity of surrounding rocks has been determined to be very low. This statement assumes that excess compaction of the fill surface will be avoided in order to assure prompt establishment of dense ground covers to prevent surface erosion, and effective mulching plus appropriate terracing will be practiced wherever necessary to prevent erosion and excess water concentration. Under such management, surface runoff will be low, in accordance with advanced planning.

6) Although the lowest points of mine pit floors may be at groundwater levels, the up-dip parts of pits may be above groundwater levels and, therefore, subject to some degree of aeration and possible oxidation of pyritic minerals.

7) Information that we have seen fails to show that a regional groundwater table exists at a level that would cover all of the potentially toxic cleaning plant rejects scheduled for placement on mined-out

pit floors. Water levels noted in a few test wells in very slow permeable materials with low water delivery capacities suggest pockets of perched groundwater that are not effectively connected with the lower lying regional water table determined by rivers and lakes.

8) The estimate that 8 to 30 years will be required for surrounding groundwater to fill mined-out pits and the pre-mining groundwater level suggests that the filling process will be too slow to prevent serious acid-formation from cleaning plant rejects placed on the pit floor. However, we would estimate that precipitation on the backfill, with good surface soil management, will contribute more water to the backfill than will the very slowly permeable surrounding rocks. Even so, it seems likely that neutralizing overburden must make a very important contribution and is the key to acid prevention.

9) General information for the Quinsam mine indicates that neutralizing capacities of overburden are considerably greater than acid and potentially-acid capacities involved. It is likely, therefore, that serious acid outbreaks will not occur. However, available data lack the detailed specificity needed to assure that all hazardous horizons can be recognized and blended with surplus neutralizers or segregated for special handling or separate disposal, if some unexpected problem develops. Such a problem could occur if a thin or slightly hazardous material should thicken or intensify unexpectedly, requiring special handling or some other immediate action. The special handling might involve sandwiching between carefully compacted layers of strongly calcareous mudrocks.

10) Available data show that the #1 seam and splits are low in total sulfur (less than 1.0%), and comprise over 70% of the total reserve at the Quinsam minesite. Data show the floor or pavement of the #1 seam to be extremely low in sulfur and associated rocks tend to be high in calcium carbonate equivalent materials which generally express free carbonates (Fizz).

11) Available data show that the #2 and #3 seams comprise high sulfur coals (1.0-2.5%), and account for about 30% of the reserve. Associated rocks, especially those zones immediately above and below the coals, are potentially acid-producing. The relative amounts of these materials are stated to be approximately 6% of the total volume of materials. One would suggest that with proper sampling procedures, the volume of these zones would be expected to be less. This statement is based merely on the experience of this investigator.

12) Calculations show that, excluding preparation plant refuse, the amount of neutralizing materials versus potential acid-generating materials are as great as 15:1 in some areas, and may be as low as 8:1 in others. These ratios are high enough to preclude acid generation, if proper material handling techniques are incorporated.

13) Preparation plant refuse that is to be returned and buried back into the active pits comprises approximately 2% of the volume of the backfill. Even though this material demonstrates a potential for acid generation, there are sufficient neutralizing agents that can be manipulated in order to incorporate burial techniques that will not generate acid.

14) Mine management as well as regulatory inspectors must be well trained in identifying potential acid hazards at the mine-site. The inspection force must understand that changes are sometimes required in backfilling procedures which are due to changes in the physical and chemical character of the site. These changes require immediate action by mine personnel and have to be implemented on-site prior to the approval of multiple agencies. Therefore, it is imperative that the regulatory responsibility lies with one agency when making these decisions.

Recommendations

1) Prior to the implementation of the final mining plan, the Company should strengthen its geochemical data base by incorporating an additional drilling program to collect acid-base data on individual rock strata.

This additional information should include all the pertinent data which are detailed in this report and outlined in the U.S. Environmental Protection Agency publication EPA 600/2-78-054, Field and Laboratory Methods Applicable to Overburden and Minesoils, March, 1978. Strict detail should be given to sampling techniques which will quantify and qualify the exact chemical nature of the entire overburden horizons.

2) The data and information that are gathered during this phase should be reviewed by a competent professional with experience in acid generation and material handling techniques. At this time, the material handling plans can be completed with a much greater degree of certainty and validity.

3) The available data for each pit show that carbonate levels are reasonably high; hence, acid-consuming materials are much greater than acid-generating materials. However, without more cores and analyses, there are uncertainties, not only about neutralizing capacities, but even more regarding thickness and intensity of potentially acid horizons, and how to recognize or anticipate them and their variations during mining. Usually, there are definite criteria to recognize and anticipate changes when you have adequate data. The number of cores required for adequate overburden sampling is variable with each site. One rule based on general experience is that mining should usually be conducted within a distance of one kilometer from a carefully sampled and analyzed overburden column. Certainly, at least three cores per pit for overburden analyses of carefully identified horizons should give a much clearer picture than one core per pit. The number of cores could well be variable with pit size, and only those pits which are to be mined during the initial mining phase may need to be evaluated at this time.

4) Monitoring wells should be constructed and maintained in order to gather data on both quality and quantity of groundwater in each of the pit areas. This is important because plans show that cleaning plant refuse is to be buried on the pit floor below the water table and, hence, there will be no chance of potentially acid-generating materials becoming oxidized and producing acids. If the cleaning plant rejects are to be buried on the pit floor, they must be under water at all times, or special burial provisions should be considered.

5) In areas where cleaning plant rejects are to be buried in the backfill, and it cannot be demonstrated that they will be under water, there should be provisions for isolation, encapsulation or sandwiching. This is done by surrounding the refuse with excess calcareous material and compacted by rubber-tired vehicles or by other appropriate means. This burial technique is used throughout the eastern United States and has enjoyed excellent success where incorporated properly. The objective here is to exclude air and water to minimize oxidation, and provide an alkaline environment which will hinder or preclude acid generation.

6) It is recommended that when burying potentially acid-producing materials, they be placed totally below or above the water table. If they are placed in the "zone of fluctuation", there will be a constant wetting and drying cycle which will greatly influence the potential for acid generation.

7) In those pits which contain potentially acid-generating materials, especially the #2 and #3 seams, riders, splits, roofs and pavements, these materials should be buried deep into the backfill and blended to mixed with thick calcareous zones (zones with fizz) in the section. This will place strong neutralizing materials in close proximity to the acid-generating material. These materials will be covered with excess carbonate zones and then normal surface treatment. Burial should be off the pit flow, if the floor is a potential acid generator. These materials should not be placed near the surface due to possible future exposure. It is suggested that approximately 20-30 feet of cover be considered.

8) During coal loading in the active pits, it is imperative that coal cleanings, partings, binders, carbolith, and black shales which are remaining in the pit immediately after the coal is removed, be cleaned up and buried in the appropriate disposal site. Historically, these are the materials which cause major acid-generation problems because they tend to be indiscriminately handled, or not handled at all.

9) The mine plan proposes two mine-waste rock disposal areas. If cleaning plant refuse or potentially acid-generating materials are used in the construction of these sites, all measures should be incorporated that prevent these materials from coming into contact with air and water. All precautions should be taken to keep acid-generating material "high and dry". They should be encapsulated inside excess carbonate materials that have free carbonates (fizz). All measures should be taken to cover these materials as quickly as possible to minimize exposure time to the elements.

10) It is understood that Quinsam is already conducting leaching tests on selected overburden mixes and coal refuse material. This information, especially data generated on the coal refuse, may help answer questions as to how much acid potential exists in the cleaning plant refuse.

11) In considering soil or other earthy material for surface or near-surface placement, it is well to keep in mind that abundant carbonates or lime should be present or added, not only for the ground cover plants, but also to make sure the infiltrating water is saturated with calcium or other basic elements which will help to neutralize any acid centers in the fill, as well as to prevent the spreading of inoculation by Thiobacillas and Ferrobacillas microorganisms.

12) During the course of mining, the monitoring wells should be sampled monthly for quality and quantity parameters. Wells which were previously in natural ground should be replaced so that post-mine information can be gathered. There should be no less than two down-dip wells per pit. One should be in the disturbed area and the other just outside the boundary to be mined. The data gathered from these wells will provide valuable information about the quality and quantity of the groundwater, and should reflect the effectiveness of material handling techniques.

THE FINDINGS, CONCLUSIONS AND RECOMMENDATIONS OF THE COMMISSION

THE FINDINGS, CONCLUSIONS AND RECOMMENDATIONS OF THE COMMISSION

The Commission, in its evaluation of the environmental issues associated with the Quinsam Coal Project, has reviewed and studied all of the evidence submitted at the hearing. It has combed through this evidence and summarized that which it considers to be the most important made by each of the participants. These summaries are recorded in the foregoing sections. Also, in its investigation, the Commission has studied a number of technical papers, principally in relationship to suspended solids and nutrients.

In addition to the reviews of the evidence presented at the hearing, and that contained in the technical literature, the Commission also visited the mine-site on two occasions, and investigated the physical properties of the area involved. The Commission also visited the Widco open-pit coal mine operations in Centralia, Washington, U.S.A., and studied its operations, reclamation program and environmental protection devices and installations.

1. GENERAL

The Quinsam River and its watershed is indeed a very sensitive area to potential environmental damage from the operations of the open-pit coal mine. The system and its watershed have the characteristics of a virtually undisturbed natural environment. The system also sustains a vigorous and valuable fishery, both in the river system itself and in the surrounding salt waters of the Campbell River area. The protection of this fishery and the protection of the pristine environment of the Quinsam system are extremely important to both the economic and recreational well-being of the people of Campbell River.

The people of this area, after having witnessed the degradation of the Campbell River system through the development of other mining operations, forest industry operations, and the hydro-electric installations, are very fearful that if the Quinsam Coal Project is allowed to proceed, the same thing could happen to the Quinsam River system as has happened to the Campbell River system. Most of the Intervenors believe that no matter how well the Company designs its environmental protection programs and facilities, and no matter how well-intentioned the Company is in regards to the operations of these programs and facilities, eventually the coal mine operations will do irreparable damage to both the fishery and the environment of the area involved.

The Commission, however, after having studied all of the evidence and all of the information available, which is pertinent to this project, has concluded that the project can be constructed and operated,with appropriate mitigative measures, so that the impact on the environment will be minimal. On the following pages of this section of the report, the Commission gives its findings, conslusions and recommendations on each of the environmental aspects of this project.

2) THE MINING PLAN, ACID GENERATION AND HEAVY METALS:

For purposes of its evaluation,the Commission has considered only those aspects of the mining plan which could have an impact on the environment, such as the method of blasting, the method of material extraction from the mine pits, the method of storage and handling of the extracted material above ground, the method of placing the extracted material (including coal preparation plant rejects) back into the mine pits,and slope stabilization.

Undoubtedly, the most controversial issue at the hearings was acid mine generation and its control. A number of experts from British Columbia, West Virginia, Illinois, and Pennsylvania, were brought to the hearings to testify: two by the Company, two by the Vancouver Island Resources Society, one by the Province and one staff expert from the Federal Government. The Commission used the testimony and reports of these experts to reach its conclusions and recommendations on the mining plan and potential acid generation.

Acid generation is the cause of probably the most serious effect coal mining can have on aquatic systems. Some of the waste rock in the strata proposed to be mined by Quinsam Coal as well as the reject material from the coal preparation plant have been identified as potential acid generators. The proper handling of this material to prevent the generation of acid water and to ensure that acid mine water is not discharged to the Quinsam River system must be achieved. Because of the low alkalinity (acid buffering capacity) of the Quinsam River, the discharge or seepage of acidic water could have serious effects on receiving water quality.

Acid mine drainage forms when pyritic materials are supplied with water and oxygen, and the rate of release of acidity exceeds the rate at which alkalinity can be supplied from the surrounding materials or contacting waters for neutralization. The overriding principal in the generation of acid mine water is that if the alkalinity released by materials or that already present in the contacting waters exceeds the acidity produced, then the system remains neutral or basic. In this case, the bacteria responsible for catalyzing the acid generation reactions are inhibited by the high pH,and the solubility of ferric iron is reduced - both factors inhibit acid production in that any ferric iron produced would precipitate and coat the mineral surfaces. If the acidity generated exceeds the alkalinity, then the solubility of iron sulphide is enhanced and the acid generation is increased. The resulting low pH enhances bacterial growth and puts ferric iron into a solution which increases the acidity. Once the acid reaction begins, it becomes self-propagating and all acid-producing mechanisms interact in a synergistic manner.

Control measures include one or a combination of the following measures: exclusion of water and/or oxygen; providing an alkaline environment around the pyritic material; and formulation of contingency plans to neutralize acidic waters. Commonly used methods for the prediction of acid generation are based on established methods of analyzing rock and coal material for their sulphur content and neutralizing potential. An acid-base account can be calculated for each rock unit and for the total mass of materials to be disposed of in the pit. Unfortunately, a considerable amount of uncertainty still exists due to the numerous factors which influence the reactivity of materials and the hydraulics of actual waste dumps. The acid generation process,for example, is catalyzed by some bacteria and may not be a simple chemical oxidation. Consequently, not only is excess of alkalinity over acid potential in the whole rock required to ensure control of acid generation, but also the release of alkalinity to contacting waters must exceed the release of acidity. One of the most reliable control measures to prevent acid generation is to place potentially acid generating materials so that they are continuously submerged in groundwater, thus cutting off the oxygen supply and limiting the reaction. Another standard measure is to provide a large excess of finely divided calcareous material to ensure an excess of available alkalinity. In dry areas, wastes may be located where they are permanently above the water table and sealed to exclude percolation of surface water.

Company calculations show that, excluding preparation plant refuse, the amount of neutralizing materials versus potential acid-generating materials, is as great as 15:1

in some areas, and may be as low as 8:1 in others. These ratios are considered high enough to preclude acid mine drainage,provided proper material handling techniques are incorporated into the mining plan.

The prediction of acid generation from the plant reject material poses a more difficult problem than the waste rock due to the small particle size, low neutralizing potential to sulphur ratio, and possible different acidity and alkalinity release kinetics.

The estimate that 8 to 30 years will be required for surrounding groundwater to fill mined-out pits up to pre-mining groundwater levels suggests that the filling process alone would be too slow to prevent acid-formation from cleaning plant rejects. However, it is estimated that precipitation on the backfill, with good surface soil management, would contribute more water to the backfill than will the very slowly permeable surrounding rocks. Even so, it must be concluded that neutralizing overburden must make a very important contribution and is the key to acid prevention.

Preparation plant refuse that is to be returned and buried back into the active pits comprises approximately two per-cent of the volume of the backfill. Even though this material demonstrates a high potential for acid-generation, there are sufficient neutralizing agents that can be manipulated in order to incorporate burial techniques that will not result in acid mine drainage.

Total management of the mining process,therefore, includes water control, overburden handling procedures, reclamation plans, and environmental impact amelioration scenarios integrated into the total mining operations system.

Also,of significant importance in the assessment of the mine-site for potential acid generation and the leaching of heavy metals into the mine drainage water, are the results of the column leaching tests done by Mr. Bruynesteyn in the B.C. Research laboratory.

Mr. Bruynesteyn set up five column leach tests at the time the hearing was in session, which were as follows:

- Two leach columns containing only the pyritic material from the site. This material was crushed to the consistency of the coal process plant fine rejects.
- Two leach columns containing the pyritic material from the site, sandwiched between the calcareous material both top and bottom. The pyritic material was about 8 inches in depth and again crushed to the consistency of the coal process plant fine rejects. The calcareous material was about 2 1/2 feet in depth both top and bottom (ratio 1 to 7) and partially crushed so that it could be placed in the six-inch-diameter columns.
- One leach column containing only the calcareous material from the mine site. This material was also partially crushed so that it could be placed in the six-inch-diameter column.
- The pyritic material in the columns was innoculated with acid-producing bacteria and all conditions were made as favourable as possible for acid generation to take place.
- Distilled water with a pH of about 6.9 was then allowed to percolate slowly through the columns.

The Commission visited the laboratory on February 3, 1984, to witness the tests and obtain the results to date. After some three months, it was found that the columns containing only the pyritic material were just beginning to produce acid drainage (a drop of 6.9 to 6.3 in pH), and they appeared to do so very reluctantly. It was, therefore, concluded that while the pyritic material from the mine-site would produce acid, it had a characteristic which prevented it from doing so readily, and that this characteristic would likely be more pronounced under natural conditions. Secondly, the leaching of heavy metals to date was certainly limited, and well below the allowable discharge levels in the Provincial Objectives for the mining industry.

In the two columns which contained the pyritic material sandwiched between calcareous material, Mr. Bruynesteyn reported that no acid production and no leaching of heavy metals had taken place (the pH stabilized at above 7.5). Also, in the column which contained only the calcareous material, the waters draining from this column had built up to a pH of about 7.8, and stabilized at that level. In his opinion, this indicated that the calcareous material readily gave up its alkalinity to the percolating water passing through the column.

In considering the evidence of the six expert witnesses on acid generation, the Commission noted that two of the experts, those of Vancouver Island Resources Society (Intervenor No. 36), had serious misgivings about the acid generation potential of the material at the mine-site and the ability of the Company to control acid generation should it occur. As a result, the Commission spent an inordinate amount of time on the evidence of these two witnesses in an attempt to find why their evidence should differ so much from that of the other expert witnesses.

In the case of Mr. Robert Hershey, and also probably in the case of Dr. Barry Phelps, it became obvious that when Hershey made his evaluation of the adequacy of the overburden sampling, he did so on the basis of the information contained in the Sturm report of September, 1983. It should be remembered that when Sturm made that report, he was not in possession of all the overburden sampling tests and evaluations, and when he appeared at the hearing and was given the up-to-date information, he substantially altered his evidence in regard to the adequacy of the geochemical data base. Mr. Hershey's evidence, therefore, was based on incomplete information and his conclusions were not supported by the subsequent, more complete, data. The Commission concurs, however, with Mr. Hershey's suggestion that it is desirable to strengthen the Company's geochemical data and to follow the E.P.A. publication (EPA 600/2-78-054) as a sampling guide. Mr. Sobek, the Company's witness, was one of the authors of this publication.

Mr. Hershey also questioned Mr. Bruynesteyn's understanding of acid production in a coal mine setting and his method of analysis. The Commission has difficulty accepting Mr. Hershey's position in this regard in the light of Mr. Bruynesteyn's evidence, which stated that his methods have been verified by the Federal Government's Environmental Protection Service. Also, in Mr. Sobek's evidence "Laboratory Analytical Procedures" on Page 55 of this report, he clearly indicates that Mr. Bruynesteyn's methods are quite reliable and conservative in nature.

From Dr. Phelps' evidence, he stated that there could be potentially toxic material in the dragline box cut spoil dumps. From the other evidence presented, however, the dragline box cut spoil areas contained no toxic material. Notwithstanding this conflicting evidence, the Commission did note that these two dumps, as well as the other two dumps, are within the confines of the surface water containment area, and any acid drainage from any of the outside dumps would be detected and treated before discharge to the lakes.

Dr. Phelps further stated that exposed toxic strata in highwall faces do not have a reclamation plan. From the evidence, the Commission is not aware of any exposed strata in the highwalls after reclamation is completed. Any toxic strata in the highwalls will be buried some 50 to 75 feet below the finished surface.

Another potential problem was raised by Dr. Phelps regarding slope stability within the pits during mining operations. His calculations showed that the factor of safety was close to one, which means that the slope would be on the verge of failing. The Company and its consultants calculated the safety factor to be greater than 1.4.

Although the primary concern of slope failure would be the safety of mine personnel, such a failure could also seriously disrupt the selective placement zones of materials designed to prevent acid generation. The Commission asked Dr. Phelps and the firm of Klohn Leonoff, through the Company, for further analysis of this matter. Following a review of these additional comments, the Commission makes the following observations:

1. Dr. Phelps' statement that the Janbu's method of slope stability analysis prohibits use of circular failure analysis is not correct. Janbu's method is a generalized method of slices analysis which can be applied to any shape of slip surface, including circular failure surfaces.

2. The stability analysis Klohn Leonoff carried out was intended to assess the effect of placement of the zone of coal refuse within the spoil pile. The failure surface analysed did not, as Dr. Phelps implied, pass above the refuse zone, but rather through the longest plane of weak materials which is at the top of the refuse zone. This analysis seems appropriate to determine whether the refuse zone would lead to deep-seated instability of the spoil pile.

3. Klohn Leonoff carried out an analysis of a circular failure surface, using Janbu's method, taking into account the entire slope as suggested by Dr. Phelps. The analysis was carried out both with and without the proposed refuse zone, and yielded a factor of safety of 1.25, if the refuse zone is ignored, and 1.16, if it is included. The reduction in safety factor resulting from placing the refuse is less than 10%. The mechanism of shallow slope failure would still be expected to be the critical surface.

4. The Commission agrees with Dr. Phelps that a critical consideration in stability will be drainage of the spoil piles and also agrees that high rainfall is normal in the Campbell River region. However, the Commission's understanding of the Quinsam mine is that the host rock is competent. The spoil piles will contain fresh, unweathered rock and will be underdrained by clean, free-draining sandstone spoil from above No. 2 seam. Drainage of the spoil piles should not be an unusual problem on this project. Also critical to stability will be the strength characteristics of the spoil pile foundation materials remaining on the mine floor following removal of the No. 1 coal seam. These considerations and others, however, should be addressed in detail when Quinsam Coal Ltd. carries out final mine planning.

In addressing this issue, the Commission concluded that the Ministry of Energy, Mines and Petroleum Resources has staff experts and the availability of other consultants necessary to properly evaluate this potential slope stability problem. The Commission recommends, therefore, that before issuing a permit, the Ministry of Energy, Mines and Petroleum Resources, through its staff and/or consultants, ensure that the dragline spoil slope of 38° is stable and has a reasonable factor of safety.

Heavy Metals

Effluents from coal mining operations may, under certain conditions, contain elevated levels of heavy metals. These metals arise from the dissolution or direct oxidation of minerals in the rock. Under low pH conditions, concentrations can be high in certain dissolved heavy metals. In other words, the development of acid drainage could lead to a multiple element effluent problem. The elements of most concern are iron, copper, lead and zinc.

Quinsam Coal has concluded that although metal levels in the effluent have not been projected, they are not expected to be higher than background levels. Its conclusion is based on the fact that groundwater samples were not exceptionally high in metals, and groundwater pH is normally basic. Predictions are difficult to make, even with a good data base. However, the column leaching tests currently underway provide valuable data in this regard.

Based on the information provided to the Commission, under non-acid conditions, metal problems would not be of great concern, although metal levels could be elevated. The Commission hastens to add, however, that acid generation potential, its prediction, control and treatment, is directly relevant to the severity of any potential heavy metals problem, and emphasizes the need for proper acid control.

The Commission believes, however, that the monitoring of heavy metals should take place. Any increase in heavy metal concentrations should not significantly increase the background levels nor exceed the lower levels of the Pollution Control Objectives for the Mining, Smelting and Related Industries of B.C., for heavy metals.

In the light of all of the foregoing, and including the detailed information provided at the hearings, the Commission makes the following recommendations on the mining plan to deal with acid generation:

1. The Company should strengthen its geochemical data base by incorporating an additional drilling program to collect acid-base data on individual rock strata. This additional information should include all the pertinent data outlined in the U.S. Environmental Protection Agency Publication EPA/2-78-054, Field and Laboratory Methods Applicable to Overburdens and Minesoils, March, 1978. Strict attention should be given to sampling techniques which will quantify and qualify the exact chemical nature of the entire overburden. During the mining operation, additional selected cores and field grab samples also must be analyzed.

2. The data and information that are gathered as recommended above, and from the column leaching tests being carried out by B.C. Research, including the rates of release of acidity from the various types and sources of reject materials and lower shale sequences, should be reviewed by a qualified expert with experience in acid-generation and material handling techniques. At that time, the material handling plans can be completed with a much greater degree of certainty and validity. Checks should be made of the potential rates of alkalinity release of the calcareous materials. The acid-base account should be calculated for each pit and waste rock dump. These calculations should be part of the Company's submissions to Governments, and be updated annually through its normal reporting procedures.

3. The number of cores required for adequate overburden sampling is variable with each site. One rule, based on general experience, is that mining should usually only be conducted within a distance of one kilometer from a carefully sampled and analyzed overburden column. The number of cores may vary with pit size but at least three cores per pit would be desirable. One core should suffice for pit 1S because of its proximity to pits 2-3S. Only those pits which are to be mined during the initial mining phase must be evaluated initially.

4. In areas where cleaning plant rejects are to be buried in the backfill, and it cannot be demonstrated that they will be under water, there should be provisions for isolation, encapsulation or sandwiching. This is done by surrounding the refuse with excess calcareous material and compacting it with rubber-tired vehicles or by other appropriate means. The objective here is to exclude air and water to minimize oxidation, and provide an alkaline environment which will hinder or preclude acid generation.

5. When burying potentially acid producing materials, they should be placed totally below or above the ultimate water table. If they are placed in the "zone of fluctuation", there will be a constant wetting and drying cycle which will greatly influence the potential for acid generation.

6. In those pits which contain potentially acid-generating materials, especially the #2 and #3 seams, riders, splits, roofs and pavements, these materials should be buried deep into the backfill and blended or surrounded with thick calcareous zones. This will place strong neutralizing materials in close proximity to the acid-generating materials. These materials should be covered with at least 20-30 feet of excess carbonate zones and then normal surface reclamation treatment. These materials should not be placed near the surface due to possible future exposure. Controlled drilling and blasting may be necessary

for accurate material segregation and appropriate particle size during excavation. Blasting procedures used require evaluation once the mine goes into operation and the Company gains experience in the control of acid generation.

7. During coal loading in the active pits, it is imperative that coal cleanings, parting, binders, carbolith, and black shales which are remaining in the pit immediately after the coal is removed, be cleaned up and buried in the appropriate disposal site. Historically, these are the materials which cause major acid-generation problems because they tend to be indiscriminately handled, or not handled at all.

8. The mine plan proposes two mine waste disposal areas. In the construction of these dumps, it will be necessary to lay down a foundation of some two to three feet of calcareous materials. If potentially acid-generating materials are to be stored in these sites, under no circumstances should they be left on the surface, open to the atmosphere. All precautions should be taken to keep acid-generating material"high and dry". They should be encapsulated in excess carbonate materials that have free carbonates.

9. The Commission concurs with the suggestion of Mr. R. D. Barker (Intervenor No. 13) that pH be measured at three points, as follows:

   - at the outlet of the pipeline from the pits prior to discharge to the settling ponds, with a continuous recording pH meter, complete with an alarm set for a pH of 5.5. This meter will give an indication of any acid waters coming from the mine pits.

   - at the outlet of each settling pond with a continuous recording pH meter, complete with an alarm set for a pH of 6.0. This meter will give an indication of any acid waters being released on the surface areas within the containment area of the surface water drainage system.

- at the outlet of Long Lake and Middle Quinsam Lake, during the normal operational monitoring surveillance program.

If an acid problem should develop, appropriate measures are recommended in the contingency plan.

10. When the reclamation of each mine pit has been completed, each of the possible seep areas at the headwalls of each pit should be monitored on a regular basis for possible acid mine drainage.

11. When the reclamation of each mine pit has been completed, a monitoring well should be drilled in an appropriate location in each pit area for regular monitoring of what is happening to the groundwater of each of the refilled pits, until stable conditions are reached.

Contingency Planning for Acid Generation

The foregoing deals with the precautions and design considerations necessary for the formation of a detailed mining plan for handling waste rock and other reject material in order to prevent acid generation. The Commission has concluded that a properly designed and implemented mining plan should virtually assure the prevention of the formation of acid waters.

However,in view of the sensitivity of the receiving environment to the discharge of acid waters, the Commission recommends that a contingency plan and mitigative measures be developed, including the engineering design, prior to commencement of mining to address the steps to be taken in the event that acid mine drainage does develop.

The Commission emphasizes that the contingency plan should be a safety factor to deal with unforeseen circumstances and should not substitute for the design of acid preventive measures in the mining plan.

The Plan the Commission envisages would require a lime treatment system to be available in each pit in order that acidic waters may be treated before they leave the pit. If this treatment is not successful, or if the mine experiences frequent problems in controlling the discharge of acid waters from the pits, it will be necessary for the Company to install a separate acid-water treatment pond ahead of each of the settling ponds to ensure treatment of all streams. These acid-water treatment ponds would be required to have continuous recording-controlling meters and automatic lime feeders to ensure that mine waters entering the settling ponds were regulated to a pH above 6.0.

Should acid waters develop on the surface of the mine-site outside of the pits, or through any seeps within or outside of the mine-site, which can be reasonably attributed to the mining operations, the Company should be required to dyke off these areas and treat the acid waters therein to ensure their neutrality before discharging them to the Quinsam River system or its watershed for as long as is required to remedy the situation.

3. RECLAMATION

Historically, the use of the land containing the coal reserves has been for the growth of forest. The lands also provide habitat for wildlife. The reclamation program should be directed to the continuation of these uses.

Reclamation is part of the overall mining plan and, therefore, must be integrated with it. It means the reasonable protection of all surface resources subject to disruption from surface mining as well as the rehabilitation of the surface resources affected by the mining.

The basic objective of reclamation is to re-establish on a continuing basis the vegetation cover, soil stability, water conditions and safety conditions appropriate to the intended subsequent use of the area. The Commission concurs with the following four specific objectives formulated by the Company in its brief to the Commission.

1. The return of the land surface to a shape which is compatible with the projected future uses in the area, and which is similar to the surrounding terrain.
2. The control of surface erosion by conducting revegetation on a continuing basis as the sites are mined.
3. The restoration of productivity on the sites disturbed by mining.
4. The development of self-sustaining ecosystems on the disturbed lands.

Towards this end, the Commission makes the following recommendations:

1. Land forms after mining, including out-of-pit dumps, should be compatible with the surrounding terrain and anticipated future uses of the area.

2. Mining should be limited to three pits at any one time but, generally speaking, one pit should be completed before starting the next adjacent pit.

3. Soil materials should be salvaged from the areas being mined. Reclaimed areas should include a minimum of one meter of glacial till covered with 0.5 meters of topsoil. Stockpiling of soil should be carried out in such a way that will minimize erosion and silt deposition to the Quinsam system.

4. A system of drainage channels and interceptor ditches should be built to control surface waters throughout the life of the mine. Once mining areas have been reclaimed, the drainage channels should be directed into their final discharge sites in a manner that will minimize erosion and silt deposition.

5. Out-of-pit waste rock dumps should have a slope of 26° with six-meter benches for each 20-meter vertical lift. Access to the benches should be maintained for drainage control and future timber extraction.

6. After shutdown, roads not required for public or industrial access should be ripped to loosen surface compaction and recontoured to conform with the surrounding terrain.

7. The buildings in the plantsite area should be dismantled and removed. Concrete foundations and slabs should be broken up and buried. Compacted areas should be ripped and contoured to conform with the surrounding terrain.

8. The land affected by mining, after backfilling and grading have taken place, should be revegetated both to control erosion and to return the land principally to forest use. The plan would

include a grass legume cover and hand-planted trees in a manner approved by the Forest Service as well as permitting departments. Species of grass and legumes that have the ability to stabilize the soil and prevent erosion should be selected as necessary. Grass species that thrive in a wetter environment and in drainage ditches and ponds that have the ability to act as a filtering medium to prevent siltation, should be established in these areas.

9. The settling ponds may be left as wetland areas but must be stabilized to ensure that erosion will be minimized.

10. Reclamation should be generally completed not more than two years after completion or abandonment of mining in each pit area.

In order to ensure that funds are available to complete reclamation in the event of a cessation of mining, either during the life of the mine through bankruptcy or poor coal markets, or after mining has been completed, the Commission has recommended appropriate bonding arrangements in Item 12 of this section of the report.

4) MIDDLE BAY BARGE LOADING FACILITIES AND HAULAGE ROUTE

Facilities which are required to transport the coal from the proposed mine-site include; a truck transportation system, a barge loading facility and a barging system that will transport the coal to a British Columbia port for overseas shipment.

In 1978, a dock at Tyee Spit was preferred by the Company for coal storage and loadout facilities. This site was subsequently rejected because of government, local and environmental group concerns. An alternative site was selected at Middle Bay, approximately five km. north of the Tyee Spit, and nine km. north of Campbell River. Because ocean going vessels could not be accommodated at Middle Bay, it was necessary to construct a barging and trans-shipment facility.

The required marine and shore development at Middle Bay (5.8 ha) will consist of a covered truck dump, a 7,500 tonne covered coal stockpile and barge loading facilities to handle approximately 18,000 tonnes of coal per week.

A number of alternative haul routes from the mine site were studied. The Company selected an on-highway route 30.9 km. in length as the preferred route. The Department of Highways reviewed the alternatives and concurred that the selected route was the only feasible alternative. It follows the Argonaut road from the mine site to Highway 28, east along Highway 28 and then north across the bridge over the Campbell River to a logging road. The route then follows the logging road north to Highway 19 and along Highway 19 to Middle Bay. A short access road is required from Highway 19 to the barge loading facility.

Middle Bay

The Middle Bay area has strong tidal currents, a scoured foreshore, and sparse eelgrass beds confined to the shoreline which provides limited habitat for the holding and rearing of juvenile salmonids.

Two small creeks drain into the Middle Bay area; one, 200 meters north and the other, 560 meters north, of the proposed facility. Both streams have limited capacity for fish production.

The Fish and Wildlife Branch rates waterfowl values in the Middle Bay areas as low. There is moderate use by some waterfowl during periods of heavy winter storms.

The results of the archival search indicated that there are no known archeological or heritage sites at Middle Bay.

Impacts on the wildlife and marine environment, therefore, are expected to be minor because of the small surface area of the facility and the nature of the operation. Some disturbance will occur during construction but if appropriate precautions are taken, it will not be significant. Inter-tidal habitat disturbed during construction should re-establish quickly after construction.

To prevent or mitigate the airborne release of coal dust to the surrounding area, the Company plans to construct a covered storage and load-out facility. The discharge from the covered stockpiles and truck dump will be treated with bag-type dust collectors. The fugitive emissions from conveyor transfer points should be controlled by fine water sprays. The total particulate emissions are estimated to be 5.5 mg/mol. It is anticipated that the largest source of emissions of fugitive dust, however, will be from the barge-loading facilities. In order to control these emissions, the Company plans to install an oversized conveyor system with rain and wind deflectors and a continuous recording anemometer to measure local wind conditions to assist in the selection of appropriate loading times.

The Commission has reviewed all of the other plans for the installation at Middle Bay and finds them to be generally acceptable. The Commission, however, does make the following recommendations, most of which have been incorporated into the proposed design of this facility:

1. The Company should endeavour to construct the facilities during a relatively dry period of the year to avoid excessive runoff of disturbed earth to the sea.

2. Roadside ditches should be provided to contain runoff from the roads and dump area and convey this material to a settling pond. A similar ditch around the covered coal stockpile should also convey the runoff to a pump where it can be pumped to the settling pond. Water from the settling pond should undergo primary treatment to remove oil, grease and suspended solids in accordance with Ministry of Environment requirements for discharge. Ditches should be provided around the perimeter to divert upstream water draining to the site, away from the coal stockpile and other facilities.

3. Domestic sewage treatment for the service building should be provided by a septic tank or packaged sewage treatment plant and disposal field.

4. A security chain-link fence and lockable gate should be provided around the terminal.

5. Barges should be trim-loaded and sprays provided to prevent coal dust losses to the sea during high winds.

6. The Company should develop standard controlling procedures for operation of water sprays at the barge loading facility and for loading based on the speed and direction of the wind as determined by the Company's Middle Bay anemometer.

Haul Route

There is considerable urban, rural and industrial activity in the area of the haul route. The proposed haul route is generally already in existence with the exception of short new sections at the mine-site and at Middle Bay.

It was suggested at the hearing by Vancouver Island Resources Society (Intervenor No. 36) that a left-turn lane be constructed off Highway 28. Studies indicate, however, that traffic volumes do not warrant a left-turn lane. Moreover, if such a left-turn lane were constructed, then the right-of-way would have to be constructed on the south side of the highway. This would require removing trees and screening from the highway, which could affect noise levels for residents. The Commission recommends, therefore, that a left-turn lane not be constructed for the initial operation. Once the haul operation is underway, the intersection could then be monitored to determine whether a left-turn lane would be desirable. Any proposed measures should be reviewed with the residents along that section of highway before construction.

Similarly, the construction of an acceleration lane where the logging road meets Highway 19 is not recommended at this time primarily because upgrading of this section of Highway 19 is anticipated. Funds spent on improvements prior to the upgrading may not be justified.

The coal haul operation, once started, should be monitored and improvements undertaken as circumstances dictate.

Transportation Vehicles

The Company plans to haul the coal from the plant site to Middle Bay with covered trucks. In addition, a truck-wash facility is to be installed at the plant site. The impact on air quality along the haulage route is expected to be minimal, providing the truck covers and wash facilities are properly operated and maintained. The Commission does not consider the setting of air quality levels along the haulage route to be practical as road dust will be generated by other vehicles in addition to coal trucks. It is recognized that the Ministry of Environment is attempting to develop a reliable and specific method for the analysis of coal particles in suspended particulate matter. Once this is completed, then a coal particulate level should be established.

The Commission makes the following recommendations to deal with potential noise and dust problems:

1. Instructions be issued to coal haul truck operators on the methods of operating trucks in a quiet manner, particularly for deceleration and braking. Truck maintenance should reflect this commitment by the Company.

2. Coal trucks to be washed and covered to eliminate the possibility of fugitive coal dust emissions along the haul route, thus reducing potential impacts on vegetation, wildlife and watercourses.

5. GROUNDWATER:

The Commission has examined the evidence presented by the Company on the groundwater geology and hydrology of the proposed mine-site, and finds that both the rock and unconsolidated deposits in the mine area have a very low hydraulic conductivity. The total existing flow through the site is given at 205 Igpm, and flows through the various pits range from 1.3 to 116.0 Igpm. The average pH of the groundwater is 8.4.

In addition, from the Company's evidence, it was stated that the flow of groundwater during mining operations would be towards the pits and away from the river and lakes. No highly permeable conduits of unconsolidated deposits or faults or fracture zones are present in the mine area which would allow seeps of undesirable substances to flow out of the mine area and into the river or lakes.

From the evidence of John Brandon (Intervenor No. 36), however, it would appear that there may be a fault zone in the area of settling ponds 2 and 3. He is concerned that under the influence of heavy blasting, ancient hidden channels may open up and allow Long Lake to drain into pit 4S, or acid generated in pit 4S to drain into the Quinsam River system. He bases this scenario on the geological information presented by the Company.

The Commission notes that Mr. Brown, of Brown, Erdman and Associates, was not concerned about this possibility. At any rate, more drill tests should be done in this area to confirm or deny the existence of a problem before mining takes place. Since Long Lake is about 70 feet deep at its deepest point, it would seem unlikely that any flow between the pit and the lake during mining operations would be in the direction of the lake.

From the evidence of Robert Hershey (Intervenor No. 36), doubt was also cast on the Company's calculated hydraulic conductivities in the mine-site area. He said that they are not representative of each overall pit area, on the basis of the "natural recharge" analysis he had made.

From his experience in Pennsylvania, Mr. Hershey, in his analysis, had assumed an annual recharge rate of 12 inches from the 47 inches of annual precipitation at the mine site. This is equal to a recharge rate of 24 percent.

The Company's consultants used a recharge rate of 10 percent, which they claim is based on their experience on the coast of British Columbia over the past 24 years.

In considering the evidence, the Commission must put much more weight on the Brown, Erdman and Associates recharge rate, as it is based on actual experience on the coast of British Columbia over a long period of time. The Commission also understands that the 10 percent figure is similar to that used by other authorities in their calculations for recharge rates on the coast. On this basis, it would seem reasonable that a recharge rate of 0.25 US gpm/acre for a 10 percent recharge should be used, instead of 0.60 US gpm/acre for the 24 percent rate.

Mr. Hershey also assumed that the total open-pit area was 1500 acres. The actual area disturbed by open pits appears to be more like 815 acres.

On the basis of the natural recharge rate being in the order of 0.25 US gpm/acre, and the area disturbed at 815 acres, the groundwater flow through the pits would be 204 US gpm, and not the 900 US gpm as Mr. Hershey proposed.

Mr. Hershey's evidence, when corrected to the proper input data, tends to confirm the Brown, Erdman and Associates' predicted figure of 205 Igpm (246 US gpm), which was obtained through pump test data and calculated hydraulic conductivities.

Mr. Hershey's statement, "that the difference between his 900 USgpm figure and the Company's 205 Igpm (246 USgpm) figure most likely explains Quinsam's failure to appreciate the importance of bedrock fracture-controlled groundwater flow", now appears to be invalid.

In summary, the Commission believes that the groundwater geology and hydrology are very favourable for the development of the mine. The flow of groundwater through the site is very low. There also appears to be no highly permeable conduits of any type which would allow contaminated water from the pits to flow into the groundwater system, the lakes or rivers.

Notwithstanding the above statement, the Commission recommends that an appropriate number of wells be drilled outside of the area to be mined to monitor the quality of the groundwater during and after mining operations. One well should be placed on the possible fault area referred to in Mr. John Brandon's testimony. The number of wells required should be left to the Ministry of Environment to decide, but probably should not exceed 12 in number for all of the pits.

Should any significant groundwater contamination develop, as measured in the monitoring wells, from the mining operations, the Company should be required to find the source of the contamination and correct the situation by any reasonable means possible, such as sealing off the source of the contamination with lime or crushed calcareous material and/or flushing and flooding the contaminated area with alkaline water.

6) SURFACE WATER MANAGEMENT

The water management plan proposed by the Company utilizes various at-source erosion controls together with four major downstream settling ponds. The Commission has reviewed the proposed plan for the collection of both mine pit groundwater and site surface drainage water, including the general design of the settling ponds and their method of operation, and has found the system to be generally acceptable subject to approval of the detailed design by Government Agencies. The key issue, of course, is the level of suspended solids in the effluent from the settling ponds.

As explained in the submission of the Federal Departments of the Environment and Fisheries and Oceans, excessive sediment can have a negative impact on fish production.

The Commission reviewed what it considered to be some of the more comprehensive literature reviews available on the effects of suspended solids on aquatic life. There is much qualitative information available on the effects of high suspended solids levels on fish production but a dearth of quantitative information on the effects of the low levels of suspended solids that would be encountered as a result of the Quinsam Coal development. The following are some of the conclusions of four papers reviewed by the Commission:

Following a very thorough analysis of possible silt pollution from a placer operation, Mr. A.C. Cooper, of the International Salmon Fishery Commission, arrived at the following recommendations for the protection of sockeye salmon. (1) "All suspended sediments in the effluent from such basins should be less than 0.1 mm in diameter, and during the period July 1 to April 1, the turbidity of the effluent should be less than 25 ppm."

The European Inland Fisheries Advisory Committee promulgated protective standards on salmonid and other fish types, and the Committee on Water Quality Criteria, 1973, relied strongly on this study.(2) They concluded that a maximum concentration of 25 mg/l in receiving waters provided a "high level of protection", and 80 mg/l provided "moderate protection".

A paper(3) prepared by the Canadian Department of Environment and Fisheries and Oceans states, "a number of authorities in North America and elsewhere have indicated that healthy fish populations can be maintained when effluent discharges to streams were at or below 25 mg/l suspended solids." (Thurston, et al, 1979 EIFAC, 1965 USEPA 1973).

Another paper,(4) published by FAO of the United Nations on water quality criteria for freshwater fish, concluded "there is no evidence that concentrations of suspended solids less than 25 mg/l have any harmful effects on fisheries".

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[1] Almo J. Cordone and Don W. Kelley, The Influences of Inorganic Sediment on the Aquatic Life of Streams.

[2] Darwin L. Sorenson, Margaret M. McCarthy, E. Joe Middlebrocks, Donald B. Porcella, "Suspended and Dissolved Solids Effects on Freshwater Biota; A Review". A report prepared for the Environmental Protection Agency, April 1977.

[3] "A Rationale for the Suspended Solids Standards for Yukon Streams Subject to Placer Mining". Prepared by the Department of Environment and the Department of Fisheries and Oceans for the Inter-Departmental Committee on Placer Mining.

4. J.S. Alabaster, R. Lloyd, "Water Quality Criteria for Freshwater Fish", Published by arrangement with the FAO of the United Nations.

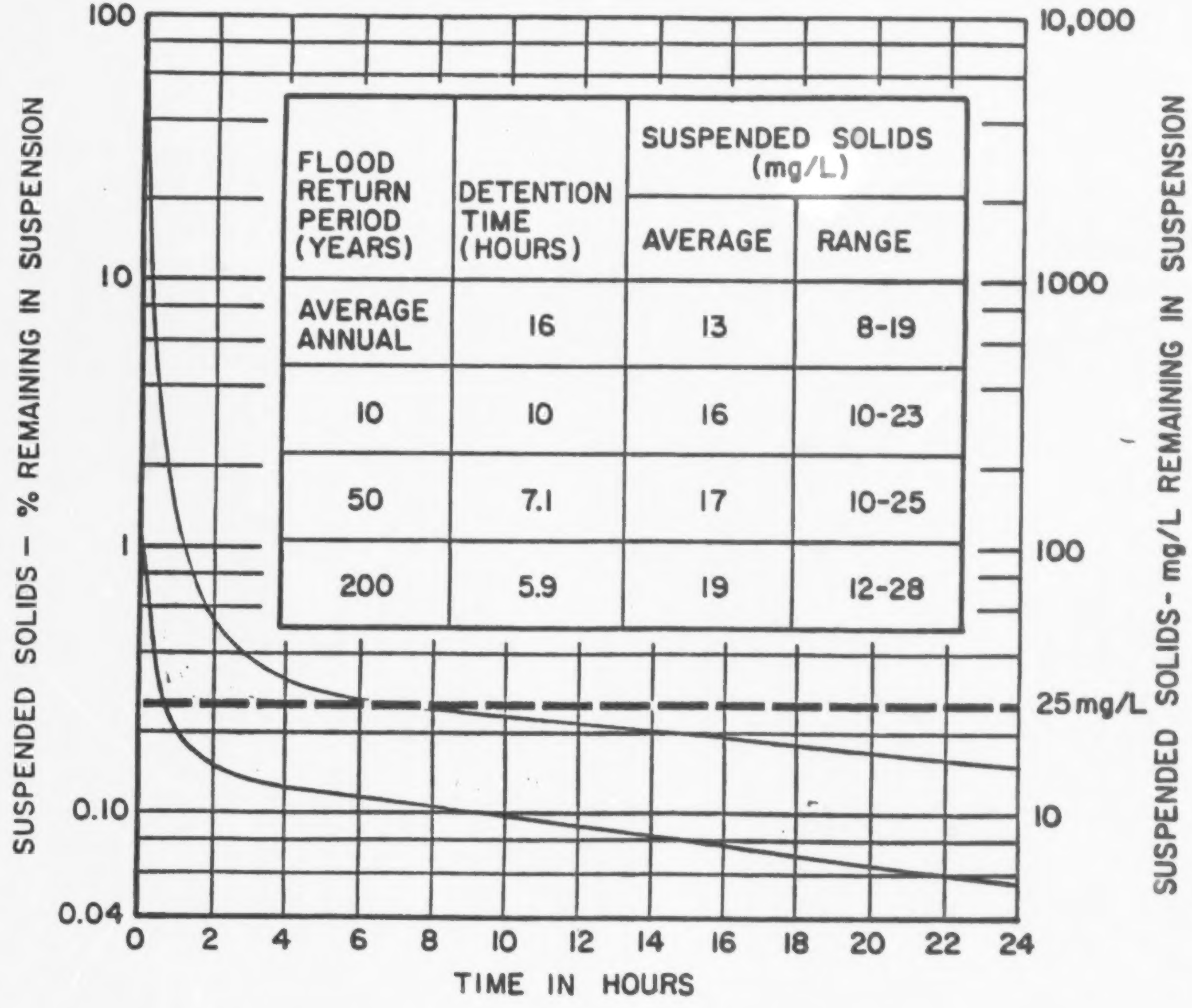
At the hearing, there was considerable discussion and confusion,not only as to what the suspended solids limit should be, but also how it should be measured. Some talked in terms of monthly arithmetic means, others in terms of composite samples, and still others in terms of the absolute maximums. There was also considerable ambiguity at the hearing and in the foregoing noted papers, both in terms of limits and whether the limits apply to effluents or receiving waters.

Based on the evidence at the hearing and the literature review noted above, the Commission recommends that the concentration of suspended solids in the effluent from the settling ponds not be more than 25 mg/l based on a 24-hour composite sample,nor more than 35 mg/l based on a one-hour sample. The 24-hour sample would consist of at least 24 samples at one-hour intervals and the one-hour composite would consist of at least six samples.

The Commission is of the opinion that these recommended maximum concentrations would provide average suspended solids levels well below 25 mg/l in the receiving waters.

The experience at other coal mines with similar settling ponds is that even with limits of this nature and above, the average annual discharge from the mines has been well below 25 mg/l. Fording Coal Ltd. averaged over a five-year period about 15.5 mg/l. Widco's average appears to be 7.50 mg/l, and the Company has stated that it expects its average to be about 13 mg/l when discharging to the Quinsam River system. (See Figure 10 on the next page). During some of the dry summer months, the Company does not expect to be discharging effluent at all.

These limits should provide a high level of protection to rearing salmon adjacent to the mine site. Spawning grounds for salmon and anadromous trout are at least two kilometers downstream from the mine-site and should not be affected if the proposed limits are met. The Commission is also of the opinion that a 25 mg/l limit based on a grab-sample would be an unrealistic requirement, and that a monthly mean requirement would be of no particular value.



FLOOD RETURN PERIOD (YEARS)	DETENTION TIME (HOURS)	SUSPENDED SOLIDS (mg/L)	
		AVERAGE	RANGE
AVERAGE ANNUAL	16	13	8-19
10	10	16	10-23
50	7.1	17	10-25
200	5.9	19	12-28

SUMMARY OF SETTLING COLUMN RESULTS

FIGURE 10

In addition to the foregoing levels set for normal rainfall conditions, variances should also be allowed from these figures for excessive runoff periods, but only to the extent that a storm is taking place, or has taken place, above the one-in-ten-year event. The limits for suspended solids in periods of this nature should be set by the Ministry of Environment when preparing the required permits.

The limits proposed by the Commission will be more stringent than the Federal Metal Mining Liquid Effluent Regulations and more stringent than any other coal mine in British Columbia.

The Commission also reviewed the proposed points of discharge from the four settling ponds as well as possible alternative locations. The Commission concluded that for ponds 1 and 4, the proposed discharge points should not cause any significant disruption to rearing salmonids. However, the Government Agencies should explore further the relative advantages and disadvantages of other discharge points. For ponds 2 and 3, the discharge point may have to be relocated because of the sensitivity of the area at the outlet of Long Lake from a fisheries standpoint. Because settling ponds 2 and 3 will not be required for about five years, it is recommended that the decision regarding the discharge point not be made at this time. Operating experience with pond 4 should be monitored and documented, and could influence the decision in this regard.

All discharges from the settling ponds should flow on the surface of the ground, through stabilized outflow channels, natural or otherwise, into the surface waters of the lake.

Chemical Flocculation

Experience has shown that natural gravitational settling in ponds similar to those proposed for Quinsam Coal cannot achieve a satisfactory suspended solids limit much of the time. Many of the particles, particularly the small particles, carry a negative charge, thus repelling each other and resulting in continuing the turbid conditions. A number of chemicals are available with a positive charge which can effectively cause flocculation of the suspended particles into an agglomeration of particles, and then gravitational settling occurs.

The Company proposes to use Calgon M-5352 (M-503), a cationic homopolymer solution, as a flocculant. In clear, non-turbid water, M-5352 can attach to the anionic gills of fish. After a period of time, a deposit accumulates on the gills which is deleterious to fish. Information provided at the hearing by Dr. J.A. McCarter (Intervenor No. 36) shows that the LC-50 (96-hour) for rainbow trout is 0.22 ppm. If, however, the polymer is added to turbid water, where it is normally used as a flocculant, the polymer attaches itself to the particles in the water and is unavailable to attach to the fish gills. It is, therefore, essential that the addition of the polymer be closely controlled to ensure that all of the polymer is used in settling the suspended solids. The local agent of Calgon told the Commission after the hearing that as long as there is a reasonable discharge of suspended solids from the settling ponds, even though that discharge is low (i.e. 5 to 10 ppm), it will be impossible for the flocculant to be carried over into the lakes.

To ensure that no excess amounts of flocculants, therefore, are introduced into the settling ponds and, hence, into the lakes, the Commission now recommends the following:

- The flocculant storage tanks must be enclosed behind a dyke so that if they are ruptured, their contents cannot empty into the settling ponds.

- A continuous controlling device must be installed at the inlet of each settling pond, which will automatically control the flow of flocculant to the effluent through a positive displacement pump.

- Individual jar tests should be carried out when flocculant is added on a regular basis to the influent of each pond.
- Tests should also be carried out on the effluent, at least during the initial operations of the mine, on each settling pond, to ensure that there is no carry-over of flocculands to the lakes.
- A continuous recording turbidity meter should be installed at the outlet of each settling pond.

In concluding its findings in connection with surface water management, the Commission noted that Mr. Gage, (Intervenor No. 15) had been concerned that some 6000 gallons of oil per year from the explosives could eventually find their way into the settling ponds and, thence, to the Quinsam River system. The Commission investigated this possibility, using the experience of other coal mines in British Columbia. It would appear from their experience that the oil evidently adheres to soil particles within the mine pits and is not discharged to the settling ponds, or if it is, is in such low concentration as to be undetectable.

7) NUTRIENTS

Increases in the nutrient supply (i.e. phosphorus and nitrogen) to the Quinsam River system could result in excessive algal growth and biomass accumulation which in turn could have negative impacts on water quality, fish production and aesthetic values of the Quinsam system.

In order to focus on the problem, it is necessary to understand the limiting nutrient or element concept. In a simplified way, the concept is as follows:

> In order for algae to grow and reproduce, certain nutrients or elements are required. Given a specified set of conditions such as light, water temperature and the availability of the right nutrients, it may be expected that an algal community will develop. As this community grows and reproduces, it utilizes the available nutrients to the point where one or more of these nutrients becomes relatively scarce in supply for the requirements of the plants. Thus, production slows, having reacned the threshold level for the given element or nutrient. In this way, the production of the community and perhaps the system itself becomes limited by the supply and concentration of the essential nutrient. For example, limitation of algal growth has been known to occur in most lakes due to phosphorus or nitrogen shortages, other reports may be found attributing limitation of algal growth to micro-element shortages such as iron or vitamins, and still other reports pointing to factors such as turbidity and light.

For the Quinsam system, the potential problem arises because of increased nitrogen loads, primarily from nitrogen-based explosives used in blasting.

Without nitrogen removal from the mine-site water, the expected nitrogen concentrations in the Quinsam River system will increase from the present range of 0.003 - 0.148 mg/l to a range of 0.4 - 3.59 mg/l, more than a 25-fold increase. Increased algal growth could occur in the system if the present nitrogen levels rather than the phosphorus levels in the system limit algal growth and/or if future phosphorus loading from the mining operation or other sources increases during the life of the mine. Whether or not a problem would develop depends on the amount and interaction of such phosphorus loadings with available nitrogen.

The Company and the Department of Fisheries and Oceans came to different conclusions on the basis of the initial data.

The Company has concluded that more nitrogen is currently available than necessary for the amount of available phosphorus. Also, because of the low nutrient availability in the Quinsam surface waters, and the phosphorus limitation for algal growth, the Company has concluded that nitrogen addition to the Quinsam drainage would have limited effect on algal growth.

The Federal Departments of the Environment and Fisheries and Oceans, on the other hand, had two concerns with the initial data presented by the Company. First, they point out that the phosphorus and nitrogen data tabled by the Company appear to contradict the conclusion that phosphorus is limited. They state that from the Company's evidence, there are levels of phosphorus which are two to four times higher than the productivity levels (chlorophyll) would indicate. Thus, either the lakes are severely nitrogen depleted with some intrinsic characteristic that inhibits the growth of nitrogen-fixing net plankton or that some of the phosphorus and inorganic nitrogen data as presented by the Company are inaccurate. Their second concern is that not enough evidence or scientific data has been presented to support the assumption that phosphorus loads will not vary in the future.

With regard to the first concern, they go on to say that "the conclusion that phosphorus is the primary nutrient limiting lake productivity is probably valid and is consistent with the Department of Fisheries and Oceans' extensive (7 years) limnological database on coastal B.C. and Vancouver Island lakes". In other words, they agree that the Company's conclusion about phosphorus limitation is probably valid but some of their data does not reflect the current nutrient condition of the Quinsam system.

Because of this apparent inconsistency of data, the Commission requested a review of the reliability of the various data sets. Representatives of the five laboratories that were involved with nutrient analyses met to review sampling and analysis procedures under the chairmanship of Paul Kluckner from the EPS/DFO Laboratories. These laboratories included the EPS/DFO Laboratories in West Vancouver, the Inland Waters Water Quality Laboratory in North Vancouver, the ASL Analytical Service Laboratories in Vancouver, the Pacific Biological Station in Nanaimo, and the B.C. Environmental Laboratory in Vancouver.

Following the investigation of the reliability of the various data sets from the five laboratories, the consensus conclusion was as follows:

> "Sampling procedures used in the Quinsam studies were generally compatible and within accepted guidelines for low-level nutrient studies. Samples were shipped to the laboratories and analyzed within acceptable time limits, except for some of the data derived by PBS: sampling and sample processing were not under the direct control of the laboratories. Therefore, we can make no assessment of the variability contributed by the limited size of some of the data sets or the significant spatial and temporal variations between data sets."
>
> "Analytical procedures were found to be compatible and in fact are basically equivalent. All laboratories were aware of the potential for contamination and sample deterioration associated with low nutrient concentration, and have taken appropriate precautions to detect and minimize any occurrences. The inter-laboratory study, combined with precision and accuracy data published by each laboratory, shows that given the same sample, all laboratories can arrive at the same results within 95% confidence limits."

"We conclude that variations in the data sets presented to the Inquiry cannot be accounted for by analytical variations. Concerns that laboratory data are inaccurate are unfounded. The imprecisions associated with quantification of nutrients near the analytical detection limit, along with the variables associated with sampling techniques, times, locations and data set sizes, must, however, be considered in any interpretation of the data sets."

- The Commission in assessing all of this information did note that nutrient concentrations in the Quinsam are close to the minimum detectable levels for common analytical methods, and, hence, probably more subject to error than measurements taken at higher concentrations.

At any rate, the Commission, after examining the broad spectrum of evidence presented at the hearing on nutrients, came to the conclusion that the productivity of algal growth in the Quinsam River system at this time was probably phosphorus limited. This conclusion is not inconsistent with the conclusions of the Company, the Federal Agencies and the Ministry of Environment. Because of Dr. Stockner's (Federal Government) evidence, however, the Commission was not as certain that phosphorus would continue to be sufficiently limited, once the mine went into operation, to prevent future algal problems in the lakes and river systems.

Dr. Stockner pointed out that if phosphorus was not curently limiting, then once the mine started operations, and provided there was no phosphorus discharge from the mine, or that the discharge was small in quantity, there would be an increase in algal growth until phosphorus did become limiting. He said that if this increase is only a small increase in lake productivity, it could be beneficial in that it might enhance the lake fishery.

Dr. Stockner's main concern, however, was that he did not know what quantity of phosphorus would be released to the system because of the mining operations. He pointed out that phosphorus could be released from the disturbed soil of the mine-site, from the groundwater pumped from the mine pits, from the mine sewage system and from fertilization of plant growth during mine reclamation. He also pointed out that phosphorus could come from outside of the mine-site in the way of precipitation (rain and snow), and from forest industry operations in the area. He also said that if oxygen becomes depleted in the surficial and deep water of the lakes as a result of mine operations, then latent phosphorus, which had been laid down over the past 8,000 to 10,000 years, could be released from the lake sediments, with possible deleterious results causing uncontrolled algal growth throughout the whole Quinsam system.

Because of Dr. Stockner's evidence, the Commission decided to carry out an investigation of its own to determine the following:

1) What are the possible sources of phosphorus additions to the Quinsam lakes?

2) What are the quantities of phosphorus that could reasonably be expected from these sources?

3) What are the mitigative measures that could be taken to reduce or prevent these phosphorus additions?

The results of the Commission's investigations are as follows:

1) Eutrophication Level -

Phosphorus additions to the Quinsam system which would raise the levels of phosphorus to a range of 0.005 to 0.01 mg/liter could trigger eutrophication of the system (i.e. excess algal growth and deterioration of the water quality).

2) Sewage Treatment -

Sewage from a construction work force of up to 400,and then an operating work force of 246,will be treated and discharged to a drainage field. The treatment plant, and presumably the drainage field, would be located approximately 750 meters from Middle Quinsam Lake but only 100 meters from settling pond 4. The Ministry of Environment has calculated that, assuming a minimum of 5% and a maximum of 30% (long term) of the phosphorus from the drainage field could reach pond 4, the input to pond 4 could range between 0.06 and 0.36 kg P/day. The Commission is of the opinion that the lower range of this phosphorus discharge could be reduced to a negligible amount if mitigative measures are taken. These measures would include the use of low phosphate detergents, moving the drainage field farther away from pond 4, and constructing a large drainage field of soils with a high phosphorus absorption capacity. The Commission recommends that the permit conditions for the sewage discharge ensure that the drainage field is separated from pond 4 by a considerable distance so as to reduce phosphorus loadings to the groundwater close to this pond. If this is done, coupled with the fact that only a third of the workforce is on the site at any one time, the Commission is of the opinion that the phosphate discharge to the settling ponds will not be significant.

3) Reclamation Fertilization

Application rates for fertilizers will be 10.5 kg.P/ha. and approximately 30 hectares will be fertilized per year. Fertilization application to reclaimed areas will be limited to specific times of the year and phosphorus from fertilizers should be quickly bound up in the soils. Estimates by the Ministry of Environment for the amount of phosphorus reaching the settling ponds range from 4% to 15% of the amount applied. The Commission is of the opinion, however, that with good application practices, the loss would not exceed 4%, which would represent 16 kg.P/year. The Commission is also of the opinion that by utilizing additional mitigative measures, the phosphate contribution from fertilization to the settling ponds would be extremely small. These measures could include applying the fertilizer on a subsurface basis, the addition of lime to bind the phosphates to the soil, and utilization of fertilizer with either low or no phosphorus compounds. The Commission notes that the Widco mine in Centralia, Washington, applies up to 100,000 kg/hectare (120 tons) of municipal sewage waste to their reclaimed areas by subsurface methods and seems to experience no algal problems from the phosphorus in these wastes.

4) Lake Sediments -

The release of phosphorus where it exists in the sediments on the lake floor is of concern if the concentration of dissolved oxygen on the lake floor is depleted to approximately 3 mg/liter. If this occurs, a significant amount of phosphorus could be released. The Commission recommends that monitoring of dissolved oxygen continue in order to establish the probability of this occurring. The Commission also recommends that if there is a reasonable indication that hypolimnetic dissolved oxygen levels will become low enough to cause phosphorus release, that aeration of the lakes take place to prevent phosphorus from this source entering the waters of the lakes.

5) Forest Industry -

The forests in the mine-site are reported to be second growth timber of some 15 to 35 years in age. It is, therefore, unlikely that they will require any fertilization programs. It is also unlikely that the forests will be logged during the life of the mine. The Commission points out, however, that if an application for any other major development takes place which could contribute significant amounts of phosphorus and have a detrimental impact on the Quinsam system, the Minister of Environment could issue an environmental protection order under Section 4 of the Environment Management Act to restrict the development. This section permits the preparation of an environmental management plan for the locality that would be affected by the detrimental environmental impact.

6) Settling Pond Discharge Water -

The water sources for the settling ponds are made up of the following three components:

Groundwater

The range of orthophosphate in the groundwater samples is from 0.0012 to 0.051 mg/liter, with an average of 0.010 mg/liter. Groundwater discharge into the pits will be small relative to surface water inflows to the pits and to the settling ponds. The maximum groundwater flow into all pits over the life of the mine is estimated to be 28 liter/second, whereas surface inflow (monthly average) to the ponds is estimated in a normal year to range from 49 to 285 liter/second. These values would, in turn, relate to flows from Middle Quinsam Lake of about 650 liter/second during an average dry season period, and 2200 liter/second during an average wet season.

Direct Precipitation

The measured orthophosphorus levels in rainwater were 0.002 mg/liter, and less than 0.003 mg/liter in snow.

Surface Drainage Runoff

Table I gives the phosphorus content of various waters to the Quinsam mine-site and includes the results of column leach tests of Quinsam crushed sandstone and shales in 6-foot x 6-inch columns subject to slow filtration with distilled water. These data indicate an average of 0.004 mg/liter of total dissolved P, and 0.003 mg/liter of orthophosphate P.

7) Assessment of Phosphorus Loadings to the Quinsam System

Using the data presented above, the estimated combined phosphorus loadings for ponds 1 and 4 have been calculated and are given in Table II. (Ponds 2 and 3 will not be operational until after Year 5, at which point the discharge from pond 1 will be reduced until Year 7 when it will cease to receive effluent from the active pits). The assumptions made in the calculations are:

- The sewage disposal drainage field will be constructed such that no more than 5% of the phosphorus will enter pond 4 (0.06 kg P/d).
- Reclamation fertilization practices will be such that no more than 5% of the phosphorus applied will reach the settling ponds (16 kg.P/yr).
- The average groundwater concentration will be 0.010 mg/liter of P.
- The surface water concentration of biologically available phosphorus will not exceed 0.006 mg/liter of P. from the soil and precipitation.

In the opinion of the Commission, the phosphorus loadings given in the "Total" column in Table II represent a worst-case scenario. As discussed earlier, mitigative measures may be taken to reduce the contributions from reclamation fertilization and the sewage plant to negligible amounts.

Using the data in Table II and the flow data supplied by the Company, the estimated increases in phosphorus concentration in the Quinsam system has been calculated usuing the following scenarios:

Scenario - 1

Scenario 1 uses the total phosphorus loadings from Table II and represents a practical worst case condition.

Scenario - 2

Scenario 2 uses only the settling pond discharges from Table II.

The data for the two scenarios are given in Table III. These data show a marked difference between Scenarios 1 and 2. The Commission believes that the increases in phosphorus concentration will be closer to Scenario 2 than Scenario 1 if the above described mitigative measures are utilized.

The Commission has reviewed the publication by the Ministry of Environment on the Fording River mine-site, and submissions by the Company on the same subject. Table IV summarizes available phosphorus concentrations in the East Kootenay soils and the Quinsam soils. Examination of these data indicate that the concentration of available phosphorus in the Quinsam soils is considerably less than in the East Kootenay soils. Table V gives summary data for the concentration of orthophosphate from settling pond discharges and diversion ditches in the Fording area. These data show a concentration close to one-half of the values given in Table III for the concentration of phosphate in the discharges under Scenario-1, and approximately double for the Scenario-2 values. Table VI gives the upstream and downstream concentrations of total phosphate, orthophosphate and suspended solids in the Fording River. Due to the problem of uptake of orthophosphate in the immediate vicinity of the mine-site, only the total P figures in Table V have been considered. These data indicate an increase in mean concentration of 0.003 mg/liter. This increase of 0.003 mg/liter in the Fording River, considered with the higher available phosphorus content of Fording soils and the lower concentration of phosphate in Fording discharges compared to the Scenario 1 levels, supports the Commission's opinion that the increase of phosphorus concentrations will correspond to the values given in Scenario-2 of Table III.

Based on this information, the Commission has concluded that with practical mitigative measures and good management, the elevation of phosphorus concentration in the Quinsam system should be less than 0.002 mg/liter.

Mitigative Measures to Control Nutrients

There are a number of measures which may be used to control or remove nutrients from an aquatic system. Some of these are:

- Substitution:

  As discussed earlier, phosphate-free detergents and fertilizers may be substituted for the standard product.

TABLE I

PHOSPHORUS CONCENTRATION OF VARIOUS WATERS ADJACENT TO THE QUINSAM MINESITE

SAMPLE	TOTAL DISSOLVED P (mg P/L)	ORTHOPHOSPHATE (mg P/L)
Quinsam River (Site C) February 9, 1984	0.004	0.003
Bulk Sample Pit Pond in Proposed 4S Pitt February/1984	0.004	0.002
Adjacent to Reclamation Trial Area July/1983	< 0.001	< 0.001
Rain Water from Reclamation trial area in proposed 4S Pit February 9/84	--	0.002
Snow - Minesite area February/82	--	< 0.003
Column Leaching Tests (1) November 14, 1983		
CS1	0.003	0.002
CS2	0.006	0.005
C	0.004	0.002
February 10, 1984		
CS1	0.003	0.002
CS2	0.004	0.003
C	0.004	0.002

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(1) Water from column leach tests of Quinsam crushed sandstone and shales in 6 foot x 6 inch columns subject to slow filtration with distilled water.

TABLE II

ESTIMATED COMBINED PHOSPHORUS LOADINGS
(kg/d)

SITE	TIME	SEWAGE PLANT	FERTILIZER	SETTLING POND	TOTAL
POND - 4	Summer	0.04	0.04	0.03	0.11
	Winter	0.08	0.13	0.07	0.28
POND - 1	Summer	-	0.04	0.01	0.05
	Winter	-	0.13	0.03	0.16
POND - 1 & 4	Summer	0.04	0.08	0.04	0.16
(Combined)	Winter	0.08	0.26	0.10	0.44

NOTE: Above based on the following assumptions:

1. 5% loss of phosphorus from sewage disposal field
2. 5% loss of phosphorus from reclamation fertilization
3. Ground water concentration of 0.010 mg/L
4. Surface water concentration of 0.006 mg/L

TABLE III

ESTIMATED INCREASES IN PHOSPHORUS CONCENTRATION IN THE QUINSAM SYSTEM

SITE	FLOW L/S Lake Discharge	 Pond Discharge	P INCREASE (ɥg/L) SCENARIO - 1 Lake	 Pond	 SCENARIO - 2 Lake	 Pond
#4 - Inlet of Middle Quinsam Lake						
Summer	558	58	2.3	22.0	0.6	6.0
Winter	1 298	138	2.5	23.5	0.6	5.9
#1 - Outlet of Long Lake						
Summer	82	16	7.1	36	1.4	7.2
Winter	844	55	2.2	34	0.4	6.3
#4 & # 1						
Outlet of Middle Quinsam Lake						
Summer	650	-	2.8	-	0.7	-
Winter	2 200	-	2.3	-	0.5	-

$$* \ \text{Ap. ɥg/L} = \frac{\text{kg p/d}}{\text{L/s} \times 10^{-3} \times 86.4} = 1\ 000$$

TABLE IV

AVAILABLE SOIL PHOSPHORUS CONCENTRATIONS AND pH AT THREE BRITISH COLUMBIA SITES

LOCATION	SOIL DESCRIPTION	SAMPLES	AVAILABLE PHOSPHORUS (ppm)			pH		
			Max	Min	Mean	Max	Min	Mean
East Kootenay Region Line Creek (Tributary to Fording River)	Ah	17	151	6	37.9	7.8	4.4	5.7
	Bm	12	180	6	51.2	7.9	3.9	5.7
	Bf	8	331	31	122.2	6.5	4.7	5.5
	Bt	3	19	11	14.6	7.8	7.5	7.7
	Bc	1	-	-	8	-	-	4.7
Upper Elk River Valley 10 km North West of Fording Coal	Organics	-	-	-	143	-	-	6.8
	Top Soil	-	-	-	203	-	-	6.2
	Till	-	-	-	91	-	-	7.0
	Alluvial Silts	-	-	-	15	-	-	7.3
Quinsam Minesite Area Stage II Addendum	Om	2	15	6	10.5	5.3	4.2	4.7
	Bf	4	20	2	11.5	5.8	5.0	5.5
	Bf_2	3	9	3	6.7	6.0	5.5	5.7
	C	1	-	-	35.0	-	-	6.0

NOTE:
Soil Horizons:

Om - Slightly decomposed sedges and mosses
Ah - Mineral horizon with accumulated organics due to biological activity
Bt - Mineral horizon enriched in silica
Bf - Mineral horizon enriched in hydrated ions and less than 5% organic
Bf_2 - Mineral horizon enriched in hydrated ions and less than 5% organic and prismatic or columnar

Bm - Mineral horizon slightly altered by hydrolosis, oxidation or solution
Bc - Transition between B and C
C - Mineral horizon of unweathered parent material

TABLE V

MINISTRY OF ENVIRONMENT ORTHOPHOSPHATE DATA FROM FORDING COAL OPERATIONS

	LOCATION:	CONCENTRATION (mg/L)
A.	CLODE SETTLING POND DECANT	
	January 4/73 - January 28/76	0.003 to 0.004
	1980	0.003 to 0.009
B.	EAGLE POND	
	Discharge	0.011 to 0.015
	Diversion Ditches	0.015 to 0.023

TABLE VI

MINISTRY OF ENVIRONMENT WATER QUALITY DATA FOR UPSTREAM AND DOWNSTREAM OF FORDING COAL

1977-1980

LOCATION	SAMPLES	MAX mg/L	MIN mg/L	MEAN mg/L
UPSTREAM				
STATION 02-00251				
TOTAL P	21	.021	< .003	.007
ORTHO P	20	.010	< .003	.004
SUSPENDED SOLIDS	25	19	1	2
DOWNSTREAM				
STATION 02-00271				
TOTAL P	43	.037	< .003	.010
ORTHO P	61	.014	< .003	.004
SUSPENDED SOLIDS	37	117	1	19

- Sewage Treatment Design:

The sewage treatment plant drainage field can be moved further away from the surface drainage system and the field can be constructed of soils with a high phosphorus absorption capacity.

- Fertilizer Application Procedures:

The contribution of phosphorus from fertilizer applications may be reduced to a negligible amount by such measures as subsurface application, the addition of lime to bind the phosphates and omission of application next to drainage ditches and waterways.

- Forest Spray Irrigation:

The concept of irrigation of forest land is drawn from the current practices of forest fertilization using nitrogen, common on Vancouver Island as a means of promoting tree growth, and spray irrigation, used around British Columbia to dispose of sewage effluents. The combination of these techniques applied to the Quinsam situation would be to use the water from the mine pits for irrigation since these waters are those that would contain the elevated levels. Preliminary calculations based on soil information for the site and the Pollution Control Guidelines for Municipal Effluent Application to Land (B.C. Ministry of Environment, 1981) show that water could be applied in the quantity of 3,600 m^3/ha during the proposed application period of April through October. The maximum required area for irrigation during any one year would be 60 to 70 hectares per pit discharge. Pumping rate would be in order 130 to 240 Igpm which would easily be handled by standard three-inch irrigation pipes.

- Macrophytes:

Biological control of nutrients in the settling ponds and drainage channels would entail the growth and harvest of aquatic macrophytes. The growth of aquatic macrophytes in the settling ponds has been tested during the reclamation research program at the site. Cattail (Typha Latifolia) were transplanted to the small pond in the 4S pit area where they have flourished. Cattails are one of the aquatic macrophytes that has proven useful for removal of excess nitrogen in wastewater. The use of aquatic macrophytes for control of erosion and the stilling of the settling pond water is planned for the Quinsam Project. Harvest and removal of these plants at the end of each growing season is expected to reduce nutrient levels.

The conclusions of the Commission are as follows:

1) Provided there is no release of phosphorus from the bottom sediments of the lakes, and that proper mitigative measures are taken to limit phosphorus additions from the sewage disposal plant and mine reclamation fertilization program, phosphorus increases in the Quinsam River system are not expected to rise by more than 0.0005 to 0.0014 mg/liter above the current background levels of 0.003 mg/liter. Therefore, phosphorus levels would be in the range of 0.0035 to 0.0044 mg/liter, which is below the level where serious algal problems would occur.

2) If the monitoring program on oxygen profiles in Middle Quinsam Lake and Long Lake indicate that oxygen levels in the hypolimnion will fall below 4 mg/liter, it would be necessary for the Company to prepare to take the appropriate contingency action.

3) If, for any reason, the phosphorus additions to the Quinsam River system from the mine's settling ponds become significantly greater than the figures given above, then it will be necessary for the Company to take appropriate contingency action, which would include pumping the pit water to a forest fertilization system during the normal period of algal growth (April to September) each year.

4) With the proper management of phosphorus additions to the Quinsam River system, and the use of the above-noted mitigative measures, if required, algal growth could be kept to reasonable limits.

To ensure that an algal problem does not develop in the lakes or river, the Commission recommends the following:

1) The permit for the sewage disposal includes conditions to ensure that the drainage field is constructed and located such that phosphorus loadings in groundwaters close to pond 4 are reduced to a minimum.

2) Mitigative measures be designed and implemented where required to minimize phosphorus input to the Quinsam system from sewage disposal and reclamation fertilization sources, as discussed earlier.

3) A program for the growth and harvesting of aquatic macrophytes in the settling ponds, discharge channels and drainage ditches be implemented to reduce the nutrient levels.

4) A plan be developed for -

    - a forest spray fertilization system for all pit waters during the summer period.
    - an aeration system for Long and Middle Quinsam Lakes.

    These plans should be developed to a stage to enable rapid implementation should ambient monitoring indicate the need for either or both of the systems.

5) Lake dissolved oxygen profiles continue to be taken on at least a monthly basis and more frequently during the winter and summer periods of stratification, or when low dissolved oxygen concentrations are anticipated.

6) Develop a program for the measurement of all possible phosphorus releases to the Quinsam system. This would include an in-depth review by Provincial and Federal Agencies, both to confirm the numbers

used in the Commission's assessment and to set scientifically-based limits of phosphorus in the effluent and in the receiving waters.

7) Following completion of the present baseline monitoring program, the Ministry of Environment, in conjunction with the Federal Agencies, should include in the construction monitoring program any additional data needed for the design or assessment of the mitigative measures.

8) Implement a quality assurance program for the measurement of nutrient levels as discussed in Section 10 of this section of the report.

8) AIR QUALITY:

The Commission has reviewed the proposed air pollution controls at the mine-site and Middle Bay, and is satisfied that with these controls, coupled with a good equipment maintenance and surveillance program, the project will have a minor impact on the air quality in the area involved.

Mine and Plant Site

The Company plans to treat air exhausted from the transfer points and bins with bag-type filters, supplemented by water sprays at the feeder/breaker points. The anticipated emission levels from the dust collectors will be 5.5 mg/mol. The range of control objectives for total particulate given in the "Pollution Control Objectives for The Mining, Smelting and Related Industries of British Columbia 1979" is from 1 to 8 mg/mol. Although an emission of 5.5 mg/mol is not at the minimum level of the Objective range, it would not have a significant impact on air quality.

The largest source of air emissions is anticipated to come from fugitive dust from the mining operation. The Company anticipates that dustfall levels will not exceed 2.9 mg/ $(dm^2.d)$. The Pollution Control Objectives range from 1.7 to 2.9 mg/ $(dm^2.d)$. The Commission is of the opinion that with good materials handling procedures, and the watering of roads for dust suppression, the dustfall levels should not exceed 1.7 mg/ $(dm^2.d)$ at project boundaries.

Haulage Route

Since the Company plans to haul coal from the plant site to Middle Bay in covered trucks, and, also, since these covered trucks will be washed when required before leaving the mine-site, it is difficult to imagine how the haulage of coal to Middle Bay will have any effect, above that of normal traffic, on the air quality along the haulage route. On this basis, the Commission does not consider the setting of air quality standards along the haulage route to be practical, particularly at this time when the Ministry of Environment has no reliable or specific method for the analysis of coal particulates in suspended particulate matter.

Middle Bay

The air pollution control measures and equipment for the Middle Bay installation are discussed at some length in Item 4 of this section of the report. It is, therefore, sufficient to say that the total estimated particulate emission from this site will be in the order of 5.5 mg/mol, and the estimated dustfall level will not exceed 2.9 mg $(dm^2.d)$, both of which are within the Pollution Control Objectives for the Mining, Smelting and Related Industries of British Columbia.

9) WILDLIFE

Because of the limited testimony given at the hearing on the impact of the mine operations on wildlife in the Quinsam area, the Commission has done its own investigation on the matter with the Fish & Wildlife Branch of the Ministry of Environment. The results of that investigation are as follows:

The mine-site area is currently covered in second growth timber of some 15 to 35 years in age. Because of this fact, and for the reasons stated below, it is not felt that the habitat at the mine-site is unique or critical.

a) In the past, prior to forest fires and logging operations in the Quinsam area, the mature Douglas fir forest functioned as winter range habitat for deer and elk. This forest no longer exists. The dense second growth that has replaced it is not old enough to function as winter range (it requires 200-300 years to acquire "old growth" characteristics), yet it is old enough to be past the time phase (0-20 years) that produces an abundance of forage in the understory shrubs and forbs. As the forage production has declined with time, so has the value of the area as feeding habitat for deer, elk and grouse (both blue and ruffed grouse). Populations of deer in the second growth in the Sayward Forest area average about six deer/square mile. It is assumed, based on studies elsewhere on Vancouver Island, that populations have to be in the order of 13 deer/square mile to be visable and usable by the public for recreational purposes.

b) The uniform dense second growth habitat of the Sayward Forest extends far beyond the area of the proposed mine, and is not unique to the mine-site. Impacts on animal populations as a result of the development would be small or not measurable on a watershed or regional basis.

In giving consideration to animals which live in the narrow confines of the mine-site proper, it will be necessary for them to migrate to other areas and most of them will do so naturally. For those that will not move, they will either be displaced, die, or have to be removed. It is the experience of the Fish & Wildlife Branch that the relocation of beavers is not feasible; however, they might well move by themselves into the natural outflow channels from the settling ponds. This would be desirable for their dams could result in the creation of small ponds and marshy areas, which would be ideal for the growing of macrophytes, which, in turn, could aid appreciably in the uptake of nutrients coming from the mine.

The concern over interruption of grouse migrations by pits, plant-site, etc. blocking the birds "flyways" is not valid. A check was made with blue grouse experts who stated that these birds migrate from winter habitat to spring breeding grounds as individuals spaced over the extent of their habitat, and that they do not migrate in narrow defined "flyways". They felt that the birds would simply migrate around the developed areas. Because the level of forage production has declined in the second growth timber around the mine, only a small number of grouse use the area as spring range.

There is an opportunity through input to the reclamation plan to actually improve the value of the reclaimed habitat for wildlife production.

In that the operation of the mine will not appreciably affect the quality of the water in the lakes or streams, and because the lakes will not be physically altered, no serious impacts are expected on waterfowl, including swans, that supposedly use the area.

10) BASELINE MONITORING

A condition of the Stage II approval was that Quinsam Coal Ltd. would undertake the development and implementation of an environmental baseline monitoring program.

In its terms of reference, the Commission was directed to "ensure that adequate baseline data exist prior to project construction and development so that subsequent monitoring data can be compared to pre-project environmental conditions". The baseline data program being conducted by the Company is described in the publication of August 4th, 1983, entitled "Baseline Data Collection and Monitoring Program for Quinsam Coal Ltd." which was tabled at the hearing. Sampling and analyses were begun in January, 1983. Preliminary results have been reported in the publications entitled "Quinsam Coal Project - Water Quality and Aquatic Biological Monitoring Studies Data Report" and "Quinsam Coal Project Fisheries Studies - Progress Data Report" dated September 27, 1983. The baseline monitoring program was designed by the Monitoring Program Technical Committee (MPTC), consisting of representatives of the Federal and Provincial Governments and Quinsam Coal Ltd.

During the public hearing, evidence was submitted by the Federal and Provincial Governments and some intervenors that while they were generally satisfied with the baseline monitoring, additional parameters, sampling locations and increased frequency of sampling were required.

In late 1983, the make-up of the MPTC was altered to include only those representatives from the Federal and Provincial Government Agencies. Subsequent to this change in the membership, the Committee then requested the Company to make a number of changes and additions to the baseline monitoring program. The Company's reaction to this request was that they already had an agreement with the Federal and Provincial authorities on the extent of the program and saw no reason to change the program until the results had been evaluated. Further, the Company took the position that to "tack-on" these additional items and changes in the middle of the existing program would not provide technically reliable data. The existing program had been underway since

January 1st, 1983 for water, and since May 1983 for biological information, and would not be completed until July, 1984. The Company, on the other hand, was not opposed to collecting additional, valid baseline data, but felt that it should be based on the results obtained from the existing program, and that these requirements be incorporated into the planned construction and operational monitoring program. The Company pointed out that the existing monitoring program was costing in excess of $20,000 per month.

During the hearing, the District of Campbell River requested Environment Canada to list all the parameters which they consider could be contaminants from coal mining operations. Subsequently, after the hearing, this list and the supporting documents were submitted by Environment Canada. A compilation of this list is given in Tables VII and VIII, following this page.

The Commission has reviewed all of the evidence in relationship to the present baseline monitoring program, and the proposed changes and additions to the program requested by MPTC subsequent to the hearing. Based on this information, the Commission has concluded the following:

a) The existing baseline monitoring program was well planned and comprehensive, although it would be desirable to make some alterations at this time.

b) The additions and changes requested by the MPTC, if approved by the Regional Waste Manager, should be incorporated into the construction and operational monitoring program after completion and evaluation of the existing program.

The Commission's recommendations are as follows:

1) Since the MPTC has now been disbanded, the senior managers of the Ministry of Environment, Ministry of Energy, Mines & Petroleum Resources, Environment Canada and Fisheries and Oceans Canada, should continue to provide a co-ordinated approach to the monitoring program, and should also provide the needed management overview to determine the relative cost/benefit of the suggested amendments.

TABLE VII

Physical and Inorganic Substances Identified in Canadian Coal Mining Discharges

pH
Conductivity
Colour
Turbidity
Hardness
TDS
TSS
Bicarb Alk.
Carb. Alk.
Acidity
Chlorides
Sulfates
Nitrates
Phosphates
Fluorides
Aluminum
Arsenic
Barium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Potassium
Silicon
Sodium
Titanium
Uranium
Zinc
Boron
Lithium
Strontium
TOC
Nitrite
Ammonia
Oil and Grease

TABLE VIII

ORGANIC COMPOUNDS IDENTIFIED IN COAL WASTE WATERS

Anthracene
Phenanthrene
Benzo (k) Fluoranthene
Dibenzo (a,h) anthracene
Benzo (g,h,i) Perylene
Indeno (1,2,3-c,d) pyrene
Bis (2-ethylhexyl) phthalate
Diethyl Phthalate
Di-n-butyl phthalate
Dichloromethane
Trichloromethane
Trichlorofluoromethane
Tetrachloroethylene
Benzene
Toluene
Ethylbenzene
1,2-Dichlorobenzene
Naphthalene
1-hexyl-3-methycyclopentane
nonanol
2-cyclohexen-1-one
trans-4-chlorocyclohexanol
4,4-dimethylcyclopentene
methyl-1,5-octadecenoate
(E) methyl-4-decene
adipic acid ester (hexyl)
adipic acid ester (octyl)

2. Orders and directives to the Company on the monitoring programs should only be issued by the Regional Waste Manager pursuant to the Waste Management Act. This procedure has the advantage to government that the orders are enforceable. The advantage to the Company is that the orders are appealable; also under the Waste Management Act.

3. Amendments to the existing baseline monitoring program which should be incorporated into the program at this time are as follows:

   - Dissolved oxygen profiles in Long Lake and Middle Quinsam Lake should be taken at least on a monthly basis and more frequently during winter and summer periods of stratification.

   - Enumeration of the phytoplankton communities and the associated chlorophyl analyses in Middle Quinsam Lake, Long Lake and the Quinsam River below Middle Quinsam Lake.

   - Analysis should also be done of at least two samples taken from the Quinsam River below Middle Quinsam Lake for the compounds listed in Tables VII and VIII.

   - It is planned to monitor dustfall and suspended particulate matter at three sites on the haulage route. The Commission does not agree that this will give meaningful baseline data due to the many sources of pollution other than the coal trucks. It would be preferable to collect a few TSP samples using a portable sampler and analyze the samples for coal particles.

   - It is noted that a tape sampler and data logger for co-efficient of haze is planned for the mine site. The Commission is of the opinion that this technique is expensive and would not produce reliable and useful baseline data.

In connection with the use and integrity of the monitoring data, the Commission has the following comments:

a) Chemical versus Biological Monitoring

In designing the baseline monitoring program, the Company has taken the approach of concentrating on characteristics or levels of organism within the food web that would react most quickly and with the least ambiguity to potential impacts of the mine development. The Commission is of the opinion that the monitoring of biological parameters,such as the abundance and diversity of plankton, benthic invertebrates and fish, will be useful and essential for measuring long-term changes in the ecosystem, and for evaluating the adequacies of water quality objectives and permit effluent concentrations, but should not normally be used as a primary instrument for enforcement and immediate correction.

b) Quality Assurance

During the hearing, and as discussed in the section of this report entitled "Nutrients", questions were raised as to the reliability of some of the water quality baseline data. Intervenor Mr. John Keays (No. 18) also raised the question of reliability of the biological monitoring data. The Commission is extremely concerned about this issue as there does not appear to be a comprehensive quality assurance program for the data being generated by the Company and the Federal and Provincial Governments. The baseline monitoring program is very detailed and extremely expensive and must, therefore, be fully documented as to methodology and level of confidence. As stated earlier, the terms of reference of the Commission direct it to"ensure that adequate baseline data ... so that subsequent monitoring can be compared to pre-project environmental conditions". In the opinion of the Commission, a quality assurance program is essential for the monitoring program in order for a subsequent comparison to pre-project conditions to be meaningful. For the water quality parameters, the essential information is as follows:

- Documentation of sampling, sample handling and analytical methods.
- Precision, accuracy and minimum detectable concentration of the tests as determined in the reporting laboratory.
- Verification by a "round-robin" exchange of samples by participating laboratories.

The Commission notes that procedures for the above have been documented by the Environmental Laboratory, Ministry of Environment, Province of British Columbia. (1), (2).

Quality assurance of biological sampling and identification is more difficult than sampling and analyses of chemical parameters. On the one hand, some biologists advocate identification of organisms by species, followed by verification by recognized taxonomic authorities, while other biologists advocate identification only to the family level with storage of the specimen for later identification to species and verification if necessary. At this time, the Commission favours the latter approach, but recommends that a quality assurance program be established by the Ministry of Environment for the biological data consisting of the following:

- Documentation of sampling, sample handling and identification procedures.
- Preservation and storage of specimens for later verification and identification, if necessary.
- Subsequent identification to species and verification only if justified to document any environmental changes.

Footnotes: (see Page 269)

(1) "Precipitation and Surface Waters: Recommended Methods for Sampling and Site Section", Quality Assurance Sub-Group, Federal-Provincial Research Monitoring Co-ordinating Committee for the Long Range Transport of Atmosphere Pollutants.

(2) "Laboratory Quality Assurance Manual" - draft report by N.R. McQuaker, Ministry of Environment.

11) SUPERVISION AND SURVEILLANCE

The Commission considers the supervision and surveillance aspects of this project to be the most important aspect in ensuring that the Quinsam Coal Project will not cause an unreasonable adverse effect to the environment. It is noted that even those intervenors who spoke in favour of the project made their approval subject to adequate controls, supervision and surveillance. An important factor in the success of the supervision and surveillance program is the maintaining of a healthy working relationship between the regulatory authorities, the Company and the community. The Commission believes that the public hearing had a beneficial effect on improving communications between all parties, and that continued positive communication is essential to the success of the supervision and surveillance program.

The Commission has reviewed the publication of October 11, 1983, entitled "Quinsam Coal Surveillance and Supervision Program - Terms of Reference", by the Ministry of Environment. The Commission is of the opinion that this program is comprehensive and well designed, and is prepared to adopt the provisions of this document in its entirety, and recommends its implementation.

The Commission is also of the opinion that the outline of the Procedures Manual, prepared by the Company and submitted at this hearing, is comprehensive and well designed, and should accomplish the intended objectives.

At the hearing and subsequent to the hearing, there appeared to be some confusion as to the titles of the Company's and the Ministry of Environment's environmental supervision officers. The Commission had difficulty in identifying whose officer was being referred to, particularly during cross-examination. The Commission will, therefore, use the following titles in this report:

Company -	Company Environmental Supervisor
MOE -	Government Surveillance Officer

In considering the overall supervision and surveillance program, the Commission submits the following recommendations:

a) General

An Environmental Technical Review Committee of six members should be formed once the mine goes into construction. This Committee should be composed of technical representatives each from the Federal Government's Department of Fisheries and Oceans, and the Environmental Protection Service, the Provincial Government's Ministry of Environment, and Ministry of Energy, Mines and Petroleum Resources, the District of Campbell River, and the Company, for the purpose of co-ordinating and reviewing the construction and operational monitoring results. The Ministry of Environment should appoint the Chairman of the Committee. The Chairman should report to the Regional Director of Environment.

This Committee should prepare an annual review of the operational monitoring, and also prepare an interpretative report which would be made available to the public.

The Ministry of Environment should prepare water quality objectives for the receiving waters in the mine-site area. These objectives should be established for operational monitoring purposes so as to protect the use of water for the fishery, recreation, aesthetics and domestic purposes.

b) Mining Plan and Acid Generation

A key to the prevention of acid mine drainage at Quinsam Coal will be the proper implementation of the recommended mining plan. This will require not only a thorough understanding and dedication from the Company to fulfill this plan, but also a commitment by regulatory agencies to independent enforcement and surveillance. The Government Surveillance Officer must have an adequate knowledge of the principles of acid mine drainage and control measures to ensure that potential problems at the site are identified and corrected expeditiously. As such, the Government Surveillance Officer may require special training prior to assignment to the Quinsam project.

The Company should establish and equip its own plant site laboratory facility for the routine analysis of coal, soil and water samples associated with supervision and surveillance of potential acid mine drainage.

Monitoring wells should be drilled in accordance with the recommendations of the Commission in Sections 2 and 5 of this section of the report, (i.e. 12 monitoring wells outside the pits and one inside each pit). Monitoring of the wells for acid and heavy metals should be done at least once a month and should continue until stable conditions are reached. Monitoring for acid and heavy metals should also be done on a routine basis following reclamation in the in-pit wetlands, out-of-pit seeps, surface water discharge, and receiving waters.

c) Water Quality

In operational monitoring, the physical and chemical water quality objectives or permit levels should be the primary basis of enforcement rather than the demonstration of biological loss.

The settling pond effluents should be monitored on a continuous basis for flow, pH and turbidity.

Routine jar tests should be carried out to determine the correct dosage of flocculant material required for the settling ponds. For an appropriate period after start-up, periodic laboratory tests should be conducted to ensure that there is not an excess of flocculant in the effluent.

A routine water quality monitoring program should be developed following evaluation of the baseline and construction monitoring results. The parameters, methodology, and sampling frequency should be evaluated at reasonable intervals of time to ensure that the monitoring is comprehensive and cost-efficient.

Toxicity tests should be a part of the routine operational monitoring program pursuant to waste management permits issued for the settling pond discharges.

Pond effluent should be monitored on a continuous basis to ensure that the pH is not less than 6.0, or greater than 8.0.

A nutrient monitoring regime should be developed for the settling ponds, Middle Quinsam Lake, Long Lake, and the Quinsam River, following evaluation of the baseline monitoring data and the final design of the nutrient control measures.

Routine visual inspections of all drainage ditches, settling ponds and equipment should be made on a regular basis by the Company Environmental Supervisor. Corrective action should be implemented immediately for any event or malfunction that may cause a degradation of settling pond effluent quality.

If subsequent to mine start-up, the water quality of the Quinsam River downstream of the mine-site is close to the critical level of the water quality objectives established for pH, suspended solids or other important parameters, then a continuous monitoring station should be established in the Quinsam River downstream of the mine-site to monitor the offending critical parameter.

d) Air Quality

The following should be monitored on a routine basis:

- Suspended particulate matter at the mine-site and Middle Bay.
- Wind speed at Middle Bay
- Stack discharges at the mine-site and Middle Bay.

The Commission is aware of the research being conducted by the Ministry of Environment into methods for the analysis of coal particles. When these methods are proved to be reliable and specific, it is recommended that they be used for the analysis of coal particles at Middle Bay and on the haulage route. (1)

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(1) Determination of Coal Dust in Airborne Particulate Materials, Neil R. McQuade and Douglas M. Smalberg.

12) BONDING

Both the Mines Act and the Waste Management Act contain provisions for bonding. Bonding is required under the Mines Act to ensure proper reclamation of the mine-site, both during mining operations and after mining is completed. In addition, appropriate bonding may be required under the Waste Management Act to offer protection against potential environmental problems.

Looking first at the Mines Act, it is required under Section 9 that an initial bond be deposited with the Minister of Finance in an amount the Minister determines appropriate but not exceeding $2,500 per hectare of land in use and unreclaimed at any one time.

The Commission recommends that the bond be adequate to cover complete reclamation of the site, both during and after mining in accordance with the Commission's Reclamation recommendations. The bond should provide for recontouring of all out-of-pit rock dumps, recontouring of in-pit rock fills which have reached design elevations, reclamation of all contoured areas, and stabilization and vegetation of all cut banks, fills and other exposed ground associated with roads, power-lines, and water control structures. The area of land to be disturbed for bonding purposes should include, in addition to the total area of mining pits and surrounding cleared areas, areas associated with roads, hydro rights-of-way, plant site, camp, water control structures and settling ponds.

Because the mining operation will be sequential, only about one-sixth of the total 600 hectares to be mined will be actively worked at any one time. The initial bond, therefore, would be in the order of $250,000. The Commission is concerned that this amount would not be sufficient to properly reclaim the site should the operation be abandoned.

After the first year of operation, the Minister may require additional security sufficient to carry out any reclamation work that may be required.

The Commission recommends, therefore, that in each year of the mining operation after the first year, security in the amount of $2,500/ha. be deposited, as required in Section 9(1) of the Mines Act, plus an additional amount under Section 9(3) which, together, will be sufficient to reclaim the land being worked in accordance with the Commission's reclamation recommendations.

Bonding under the Waste Management Act would be in addition to that required under the Mines Act, and is considered necessary by the Commission for the Quinsam Coal development in order to offer protection against unexpected or unforeseen events which may have some potential for environmental impact. Security is required to ensure that the treatment ponds and settling ponds are capable of operating in a reasonable and satisfactory manner, and to ensure their continued operation if required after mining has ceased. Security is also required for the possible need to restore the receiving environment either during the mining operation or after mining has ceased through bankruptcy or dissolution.

More specifically, the Commission has concluded that bonding is necessary to provide for corrective actions to deal with potential environmental problems in the following areas:

- the water drainage and treatment systems, including the sedimentation ponds, flocculation equipment and acid neutralization equipment;
- emergency measures to control acid mine drainage seeps from in-pit and out-of-pit waste disposal areas.
- clean-up and safe disposal of in-pit rejects, preparation plant rejects and any other waste with a potential for acid generation.
- emergency measures to control discharges of nutrients.

The total amount of security and the term that is required to deal with the above-noted potential corrective actions is difficult to quantify. Engineering estimates can be made of the costs of specific control facilities but the costs of dealing with contaminated seeps, for example, if they should occur, could be quite high. The stringent controls recommended by the Commission are also a factor in determining the amount of the security.

The Commission would recommend, therefore, that the Company provide security based on 50 percent of the estimated capital costs of those settling ponds in operation, the equipment necessary for the disposal of the preparation plant rejects, and the emergency or contingency measures to control acid generation and the discharge of nutrients. Notwithstanding the values obtained from the proposed foregoing calculations, the Commission recommends that the bond not be less than $1,000,000, and not more than $1,500,000, during the first three years of operation. The bond should be a performance type of bond, but with 10% in the form of cash or negotiable securities, deposited with the Minister of Finance.

After each three years, an assessment should be made of the efficacy of control measures and works, and the amount of the security adjusted accordingly. Security should be provided throughout the life of the mine and for a period after mining ceases until self-sustaining biotic systems have been established on reclaimed land, but, in any case, not less than three years.

In addition to the provision of the foregoing two bonds, the Commission notes the following:

a) In an emergency, where immediate action is necessary and the Company is hesitant to take the required action, there is provision under the Environment Management Act, Section 5, whereby the Minister of Environment has the power to act immediately to correct whatever problem exists. Under Section 6 of the Act, he may also use public funds to pay for whatever corrective action he takes, and at some later date, secure payment for these expenditures by action through the Supreme Court from the Company.

b) During the cross-examination at the hearing, the Company stated that it would be normal to carry $10,000,000 in insurance, which would cover claims of an accidental nature.

The Commission now recommends that the Company make its insurer aware of this possible exposure, and that some proof be provided to the Minister of Environment that the insurance company has made provision for this possibility in the Company's insurance policy. The Company should also be required to notify the Minister of the terms of the insurance and any cancellation, amendments, etc.

13) PERMITS

The Commission considers that the necessary licences and permits, pursuant to the Waste Management Act, the Mines Act, the Coal Act, and the Water Act, can now be prepared for the mining operations, provided that in the preparation of these licences and permits, the recommendations of the Commission are observed. It is also the opinion of the Commission that it should not become involved in the setting of the detailed conditions of the licences and permits.

The Waste Management Act permits should not only include the conditions for emissions and effluent discharges from the mine-site and Middle Bay, in accordance with the Pollution Control Objectives for the Mining, Smelting and Related Industries of British Columbia, but also conditions which would relate to the required ambient air quality outside the property boundaries and the proposed water quality standards for the Quinsam River, Middle Quinsam Lake and Long Lake. In summary, the Commission believes that conditions should be set for both the individual discharges from the site and the required conditions for the receiving environment. In the enforcement of the permits by the Ministry, when there is a conflict between the two conditions, the receiving environment should take precedence, where practical.

The Waste Management Act permits should also make provision for the necessary construction and operational monitoring requirements, including the location of the monitoring stations.

Further, the Waste Management Act and/or the Water Act permits, whichever is appropriate, should set the design parameters for the hydraulic installations, including the provision that all structures be capable of withstanding the 200-year storm event, and that discharge channels to the lakes be located in an optimum position for protection of the fishery.

14) GENERAL CONCLUSIONS AND RECOMMENDATIONS:

The preceding parts of this section of the report dealt with technical recommendations that the Commission considers necessary to minimize environmental effects from the proposed mining operation. This part of this section deals with the broad conclusions of the Commission, and includes some general non-technical recommendations.

The Commission begins with the premise that the absolute safety of a mine, industrial activity or, for that matter, any human activity, from an environmental standpoint, cannot be guaranteed. Human error, extreme weather conditions or unexpected circumstances can impact upon the best laid plans and facilities. The question then arises as to whether the risks associated with the potential environmental problems are acceptable. But both the definition of acceptability of risk and the perception of risk by individuals or society are complex questions which are based essentially on value judgements. Environment Canada in its brief "considers that there are no safe levels of pollution, but rather acceptable levels of risk, the determination of which involves social, economic and environmental consideration by society".

The Commission has attempted to balance the points of view brought forward at the hearings in its assessment of the acceptability of potential risks to the environment of the Quinsam Coal project. After careful study of all factors, the Commission has concluded that the project can be constructed and operated with appropriate mitigative measures so that impacts on the environment would be minimal, but not necessarily entirely eliminated. The Commission is of the opinion that if the Company diligently meets the requirements that the Commission has recommended, the environmental problems associated with the project, including potential fisheries problems, are manageable, and detrimental effects, while they cannot be quantified, would be small. Moreover, the risks of a major environmental problem such as reduced water quality from acid generation or nutrient addition are also considered to be within acceptable limits. This latter statement is based on the premise that proper monitoring and surveillance would identify a problem before it becomes serious and appropriate contingency plans could be put into place to deal with each major area of concern.

Undoubtedly, the major environmental issue brought forward at the hearings was the possible damage to Quinsam fish production. Most intervenors were adamant that any loss to the fishery was unacceptable to the community. In order to ensure that the aggregate habitat capability and the fish production of the Quinsam system will not be diminished as a result of the coal project, the Commission recommends that if a loss should occur, and is attributable to the Company, the Company should compensate for that loss by contributing to a habitat restoration and enhancement program on the Quinsam system. Because of the importance of the Quinsam fishery, particularly to the Campbell River area, the Commission suggests that the Company should err on the side of the fish and over-compensate for any loss to the fishery resources. In view of the wide opportunities for habitat rehabilitation and stock enhancement, the Company would then virtually be assured of achieving an overall net increase in fish production from the Quinsam system, presumably at moderate costs.

The Commission has not suggested what the terms of any agreement of this nature should be, but believes a program could be developed between the Company and the appropriate Federal and Provincial authorities. This suggested approach would be in accordance with the Department of Fisheries and Oceans' working principle of no net loss, wherein the Department strives to achieve no net loss of the productive capacity of those habitats that support Canada's fishery resources.

The Commission wishes to emphasize that it is not suggesting that compensation be provided to accommodate damage to fish habitat that could be avoided through proper design and operation.

The Commission notes that the Quinsam system and its fishery have already been substantially altered by man. For example, the system's water flows are manipulated by B.C. Hydro under an agreement with the Department of Fisheries and Oceans; the watershed has already been affected by logging, mining and gravel operations; and approximately 90 percent of the current value of the Quinsam fish production originates from artificial facilities at the Quinsam hatchery or from hatchery fish planted to areas upstream from natural river obstructions.

The Commission also recommends that Governments review with B.C. Hydro the flow releases that were negotiated about 30 years ago. The water use for fisheries propagation in the Quinsam is now quite different than it was at that time. B.C. Hydro may or may not be amenable to providing additional water for fisheries purposes, but even though additional water might not be forthcoming, a different pattern of releases might improve fisheries production in the system, particularly during the low-flow period.

The Commission would also encourage the participation of the three levels of Government in integrated resource planning. Governments should be prepared to implement their responsibilities in a way that recognizes the value of co-operative resource planning with each other and with resource users. It enables managers to identify at an early stage the impact of possible developments on other interests and provides an opportunity to influence plans before irreversible commitments are made. Both Provincial and Federal agencies have indicated their agreement in principle to this process.

In addition to the foregoing, the Commission makes the following comments in regard to the hearings and the procedures for assessment of environmental impacts:

a) Scientific Data:

At the start of the Stage II Submission process, the proponent must be given very clear and precise instructions of what data are required. The Ministry of Environment should convene a meeting of the scientists likely to be involved in the project and obtain a firm agreement as to the data to be supplied, the method of obtaining the data, the method of analyzing the data, and the precision and accuracy necessary. Once this is done, it should then be binding on all parties. It is not good enough to say after the data have been collected and presented, that it is insufficient and improperly taken. As an example, the Commission found that even after years of data-gathering and study on this project by the Company and the Federal and Provincial Agencies, there was still insufficient data, even up to the end of the hearing, for the Commission to make a proper assessment of the impacts of the project on the environment. Three months after the hearing was over, the Commission was still collecting the required information in order to bring down its decision.

b) Consultation:

At the hearing, the entire broad spectrum of the technical aspects of the project came up for examination, and as a result, the inquiry took an inordinate length of time. The Commission feels that the inquiry process could have been shortened considerably if there had been pre-inquiry consultation between the key people, including Government technical staff, the consultants, the Company and the intervenors with technical concerns. These discussions could have taken place prior to the Commission being established. A great many of the issues would probably have been resolved without involving the Commission. The length of the hearing was probably in direct relationship to the lack of consensus of the various groups going into the hearing. The Commission understands that, at present, the Government does not have adequate procedures to provide this type of consultation prior to an inquiry.

c) Lead Time:

In the future, the Commission believes that it would be desirable to have the project proponent file all documentation to be presented at the inquiry at least sixty days prior to the start of the hearing, and that all other participants file their documentation thirty days before the hearing starts. It seems that that procedure would be fairer to all of the parties involved.

APPENDIX I

PUBLIC INQUIRY INTO QUINSAM COAL PROJECT

TERMS OF REFERENCE

IN THE MATTER OF THE ENVIRONMENT MANAGEMENT ACT
SBC. 1980 C.

and

IN THE MATTER OF APPLICATIONS FOR VARIOUS ENVIRONMENTAL PERMITS AND LICENCES BY QUINSAM COAL LIMITED

FOR THE DEVELOPMENT OF COAL RESOURCES ON THE QUINSAM WATERSHED ON VANCOUVER ISLAND.

Public Inquiry into Quinsam Coal Development
In the Matter of the Environment Management Act

WHEREAS Quinsam Coal Limited (the Company) desires to develop a 900,000 tonne a year thermal coal mine in the Quinsam Watershed approximately 27 km south-west of Campbell River, and

WHEREAS the Environment and Land Use Committee has approved this development in principle at Stage II of the Provincial Guidelines for Coal Development, subject to conditions set out by the Chairman of the Committee in a letter to the Company dated February 23, 1983, and

WHEREAS, the Environment and Land Use Committee has set as one of its conditions for the granting of that approval-in-principle that there be a public inquiry into the environmental aspects of the proposed project prior to permitting and licencing,

NOW THEREFORE, the Minister of Environment, pursuant of Section 7(1) of the Environment Management Act appoints a Commission to hold a public inquiry, the purpose of which is to provide advice as to the terms and conditions that the Company must undertake in order to construct, operate and abandon the Quinsam Coal Project in an environmentally sound manner.

1. Purpose of the Inquiry

(1) The purpose of the inquiry is to identify the environmental impacts of the proposed coal development and to identify measures for avoiding and mitigating these impacts such that the Minister of Environment can be assured that the project can proceed in an environmentally sound manner. Particular emphasis shall be placed upon protecting fish resources in the Quinsam watershed.

2. General

(1) This inquiry shall include all proposed development activities to be undertaken by the Company within the Quinsam Watershed, the areas adjacent to the transportation route from the property to the coal trans-shipment port at Middle Bay and the Community of Campbell River. This inquiry is to be held with the understanding that it is to preceed the granting of any permit and licence pursuant to the Water Act, the Waste Management Act, the Mines Act and the Coal Act.

3. Environmental Impacts

(1) Pursuant to Section 7(2) of the Environment Management Act the named Commission shall hear evidence on the subject development proposal with respect to the following aspects:

i The development of an acceptable environmental supervision programme and an associated set of detailed procedures for implementing it to ensure that environmental protection measures are undertaken during mine construction and operation.

ii The establishment of adequate levels of bonding under the Mines Act and the Waste Management Act to ensure that there are sufficient funds to protect the environment in case of emergencies or should design measures fail.

iii Assess the probability of increased discharges of nitrogen and phosphorus into the waters of the Quinsam River, the possibility of enrichment of these waters that will affect fish and other uses of these waters and the design of measures for the effective control of these nutrients should any problems arise.

iv Ensure that adequate baseline data exist prior to project construction and development so that subsequent monitoring data can be compared to pre-project environmental conditions.

4. Information Sources

(1) The Commission shall review the Stage II Submission plus its Addendum submitted to the Coal Guidelines Steering Committee by the Company. The Commission shall also review documents submitted by the Company to the Ministry of Environment in support of the Company's applications for Waste Management Permits and Water Licences for the development and any other data that the Company has collected as part of its baseline monitoring programme established as one of the conditions of the Stage II approval-in-principle.

(2) The Commission shall have the right to request additional information it feels may be required to achieve the purpose of this inquiry from the Company, public or from government agencies.

(3) The Commission shall consider any objections to the applications for permits made by the Company under the Waste Management Act and licences under the Water Act that have been submitted to the Ministry of Environment.

5. Recommendations, report and Timing

(1) Based on the decision of the Environment and Land Use Committee in February 1983, that the Quinsam Coal Development is in principle to the benefit of the Province, the Commission shall recommend on the terms and conditions that should be included in permits and licences pursuant to the Water Act, Waste Management Act, Mines Act and Coal Act to avoid impacts to the natural environment in the areas potentially affected by the development.

(2) Specifically, the Commission shall form its own judgement on and report upon each of the matters specified in section 3 of these terms of reference.

(3) The Commission shall submit its report complete with recommendations and supporting rationale to the Minister of Environment by December 1, 1983. In the event that there are impediments to the expeditious review of this project, the Commission shall consult with the Minister of Environment to consider ways and means to facilitate the review process.

All applications for permits and licences and technical reports submitted by the Company are transmitted to the Commission with this reference.

Dated this 10 day of August, 1983.

Anthony J. Brummet

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